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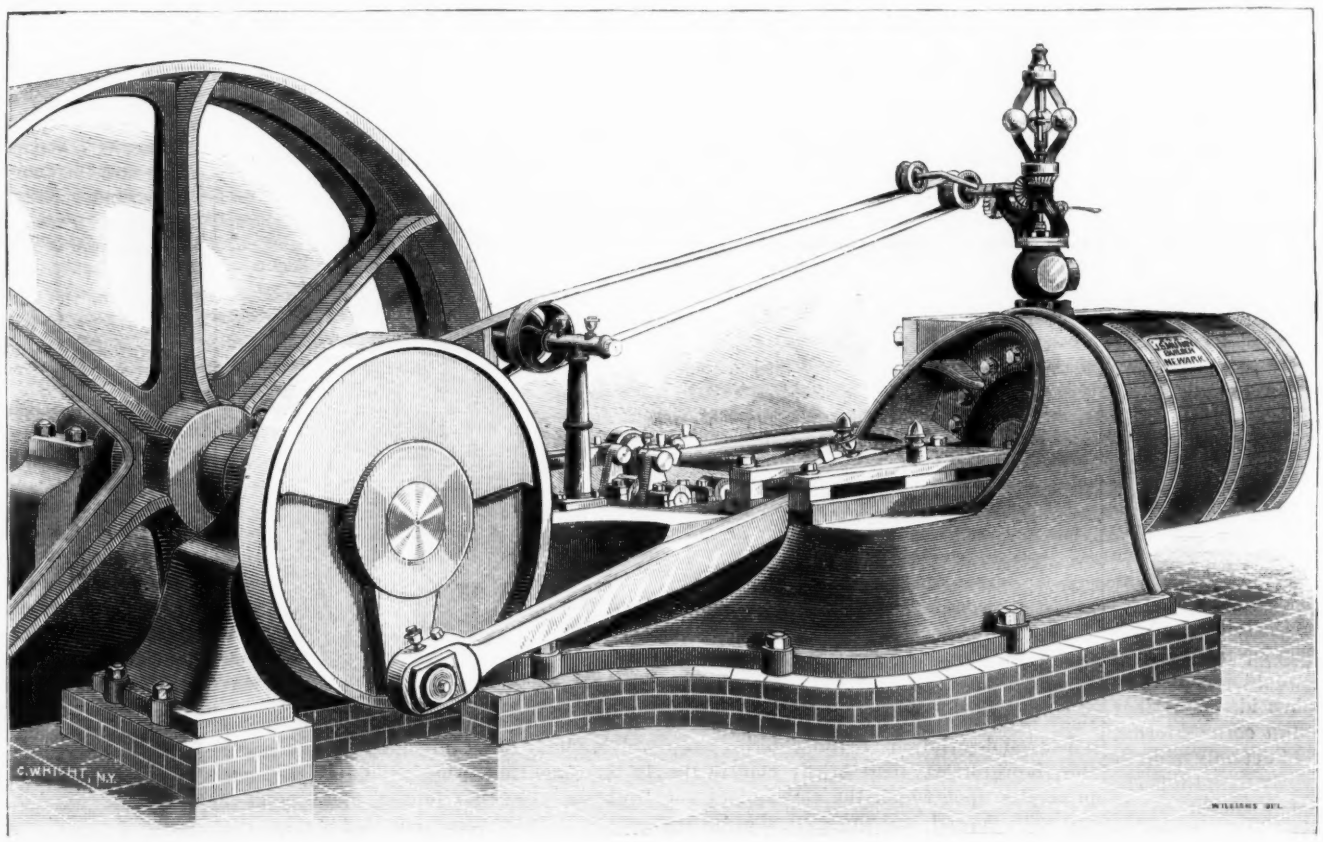
New Horizontal Steam Engine.

The engraving on this page represents a newly designed steam engine just brought out by J. S. Mundy, Newark, N. J. The main features aimed at are simplicity and strength. A very fair idea of its construction may be obtained from the engraving. The crank shaft is made of hammered wrought iron, nine inches in diameter. The bed is of the form of a turtle's back or shell, which makes it very strong, the center of power being very low and near the foundation. Strains are therefore directly in the center. Valves are made in two styles: a positive cut-off and an automatic cut-off. The engine shown in the cut has a positive cut-off, with plain slide valve operated by two eccentrics. The cut-off can be changed in a few moments to cut off at any length of stroke. It is set, as here shown, at half stroke. An arm lever connects with the cut-off valve to throw it over and reverse the engine. The cylinder is 22"x36"; main bearing, 16 in. long by 9 in. diameter; piston speed, 480 ft. per minute while running at 80 revolutions, and exerting 150 actual horse power.

The engine from which the view shown herewith was taken, is driving a flouring mill of the Cambridge Manufacturing Co., Cambridge, Md.



NEW HORIZONTAL STEAM ENGINE.

Practical Blacksmithing.—Selecting Good Iron and Manner of Doing Work.

BY FREDERICK LEWIS.

Much might be said in regard to the chemical properties and impurities found in iron, but such information does not properly belong to the subject under consideration, but rather belongs to the metallurgical branch of iron manufacture. Wrought or forge iron varies greatly in quality, the difference being chiefly due to the amount of impurities contained in it. Thus, some kinds of iron are very ductile at certain temperatures, while others are very brittle and will even break unless heated up to a proper temperature. In consequence of these differences, iron is divided into four principal classes. Iron exists, however, that possesses qualities which give it an intermediate position between those already mentioned. The best iron is that quality which is ductile and may be bent at all temperatures without breaking. It may be generally known from the appearance of the surface, it having no cross fissures. There will be no cracks at the edges or seams, and the grain will appear white, fibrous, fine-grained and tough when a bar is broken. This iron possesses the best welding properties, and is not injured by the high heat it is subjected to, while undergoing the process. It will be understood that this iron owes its tough properties to the resistance of its molecules to separation.

The second quality of iron which is classed next in order, is that which possesses the properties of being tough and malleable at all temperatures, will also weld easily and is very strong, yet will not stand as great heat without injury. When a bar is broken, it will be noticed, upon close examination, that there are little fine crystals or grains mixed with the fibers, or between them, whereas the grain of the best iron is entirely free from these irregularities.

The third quality is known as "cold short" iron, and is quite tough and ductile when hot, but when cold may be easily broken with a hammer, or even by falling upon a hard substance will be fractured. This iron is unfit for forgings that require great tensile strength, or where any great risk is involved. It is, however, peculiarly adapted for outdoor work, where it will be subjected to the action of the elements, as it is not inclined to rust as easily, and, consequently, will not waste away as rapidly as some of the better qualities of iron. This quality of iron is almost destitute of fiber, and when broken, the grain appears crystallized, or exhibits large bright surfaces.

The fourth quality possesses properties directly the reverse of that just described, and is very brittle when hot, but when cold is tough, and may be easily bent without breaking. It is for this reason called "hot-short" iron.

In forging this iron, great care is necessary, as it is liable to break at any moment. When a hole is punched near the end of a bar, it is almost sure to split. It may be welded with great difficulty, and whenever a forging is made from it, a poor and unsatisfactory piece of work is the result. This iron has a dark color, and is generally rough and broken at the edges. It can be purchased cheaply, and for some purposes, where a rough, strong iron is required, it is found very desirable. The causes of the peculiar phenomena mentioned in connection with cold-short and hot-short iron, are owing chiefly to the presence of impurities, such as phosphorus and sulphur, which have not been wholly removed in the roasting process. Sometimes these impurities are absorbed from the coal used in the furnace, hence the objection to fuel containing an excess of sulphur. Most practical men are aware of the fact that where sulphur is present in a fire, iron will weld only with great difficulty, and the weld will be imperfect. To prove that sulphur is greatly injurious to iron, it is only necessary to sprinkle a little of that substance upon a flat bar which has been brought to a white heat. The sulphur and iron will unite, forming a liquid which is sulphuret of iron.

It is said by some blacksmiths that they like to get iron which possesses an odor. This peculiarity is attributed to the presence of arsenic. Perhaps some of the readers of the AMERICAN MACHINIST have noticed this singular smell, which seems to be a strong characteristic of some of the best iron and steel.

In testing a bar of iron by bending cold, it is always best to nick it with a cold chisel, as the fiber will show better when the bar is bent. It is a good plan to split a bar in the middle and form a T. Some punch a hole near the end, and cut through the center of the bar to the hole with a chisel; but this is not as good a test for the iron as to simply split it. The edge of the hole forms a fillet, and adds greatly to the strength of the material. Improvements have been gradually made in the manufacture of iron until it has merged into low steel. There is a peculiar kind of iron which is made in England, and has been used for a number of years. The grain of this iron, when a bar is fractured, has the appearance of low steel, and is seldom detected except by an expert.

Low Bessemer steel can now be produced, by the direct process, at such a low cost that it is fast taking the place of the best iron. It will, according to the predictions of those who are competent to judge, be only a short time when homogeneous iron, which is properly low steel, will supplant iron for many purposes. Even at the present time it is being used by all the leading manufacturers. The principal reasons for this are its low first cost. It is much stronger than the best iron, having a tensile strength of 45,000 to 50,000 pounds per square inch of section, while the quality of steel referred to has a

strength of 70,000 to 75,000 pounds. Another reason is that, by the continual improvements in rolling iron, the material is produced in almost every conceivable shape, which is very convenient and economical for the consumer. A blacksmith at the present time when requiring a special shape of iron, instead of taking a large bar, and after much hard work succeeding in drawing it down to the required form and size, goes to the dealer and very soon succeeds in finding a shape which will answer his purpose with an expenditure of very little labor.

In consequence of the improvements mentioned, a blacksmith at the present day does not require as much skill as formerly, when a mechanic had to make his own iron, and all the work was done by hand. For example, in carriage work, when machine work was almost unknown, a man had to make swages to suit the different shapes. The axles had to be drawn to a true taper, and finished at a black heat, thus avoiding lathe work, leaving the skin of the iron unbroken; and it may be remarked in this connection that the axles made in the manner described, were stronger and would outwear any of the axles made at the present time. To produce these axles, the swages had to be properly tapered and shaped so as to produce smooth work.

In former times carriage blacksmiths were required to make their own springs, and, in short, all the iron and steel work about a carriage, but now each part of the work is identified as a distinct branch or trade. All the metal work was made of iron except the springs. A great many trade secrets were claimed by mechanics, particularly in the process of tempering springs. A man traveled through the country and instructed persons in those secrets for a stipulated sum, and in many cases those instructions were a deception and a fraud. By and by the trade began to split up until the present state of affairs was gradually developed. Now, the different parts of the iron and steel work of a carriage has to be procured from different manufacturers.

The Teeth of Spur Wheels—Their Correct Formation in Theory and Practice.

BY PROF. C. W. MACCORD.

No. 1.—GENERAL PRINCIPLES.

The proper action of many pieces of mechanism depends so largely upon that of spur wheels, that any means of effecting a radical improvement in the making of such wheels cannot but be of interest and importance.

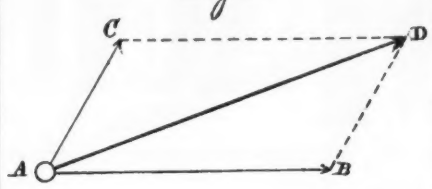
There was a time when the teeth of wheels were made in rude hap-hazard ways, of almost any shapes that would permit them to engage, with a mistaken idea that they would wear themselves into correct forms. The machine was expected not only to do its own proper work, but partly to finish itself; small wonder, then, that it failed to do either of these things well. Naturally, these crude methods gave place to better ones. The mechanician perceived the necessity of greater care in making the teeth of proper form; the mathematician soon became interested in the problem of determining what forms were proper, and the results of their combined efforts leave little to be desired in relation to the latter.

And as little would seem to be left in regard to the former after the introduction of the gear-cutting engine, by which, if the milling cutter be of the correct outline, all the teeth of a wheel are made with the utmost regularity and precision. But on closer consideration, it will be seen that something is yet lacking in reference to the formation of the cutter itself. It is one thing to know what its outline should be, but quite another thing to make it so.

The process most extensively employed involves, 1st, the laying out of the required curve; 2nd, the filing of a template to that exact form, and, 3rd, the turning of the cutter to fit the template.

In some cases a specially-contrived apparatus has been used for mechanically tracing

Fig. 1.



the curve by continuous motion, but, until recently, the two remaining steps have been executed by hand, which makes the perfectly accurate formation of a cutter, especially if it be a small one, very difficult, and its exact duplication still more so.

The time has now come when all this ought to be changed. No one who considers for a moment the vast numbers of accurate machines employed in the various industrial

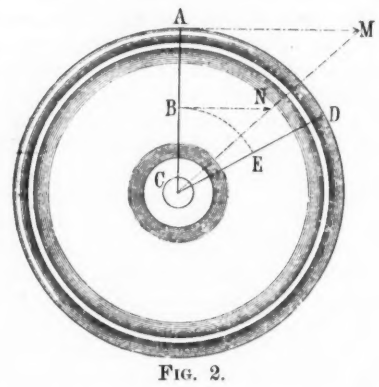


FIG. 2.

arts, and of others equally accurate employed in making them, can fail to perceive the advantages over the system above described, of one in which the template is not merely lined out, but cut out to the true form, and the contour of the milling cutter, be it large or small, is made to correspond to that of the template, by mechanism nearly automatic. Of such a system, and of the means by which

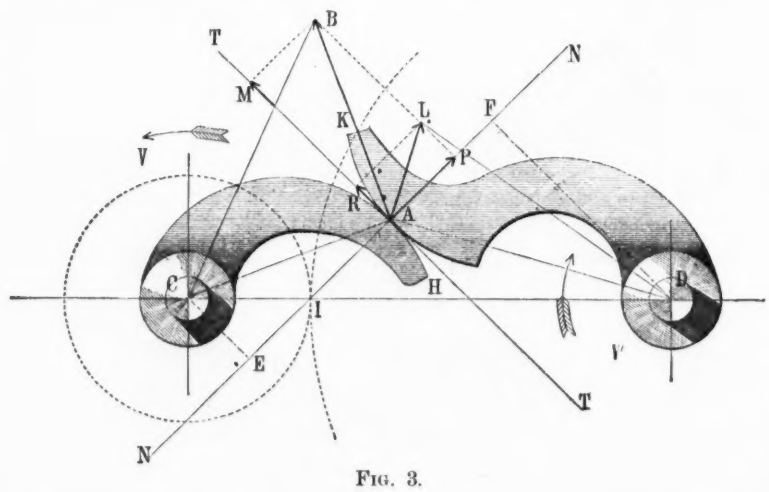


FIG. 3.

these results are effected, we propose to give a detailed description. Before entering upon this, however, we shall briefly explain the principles upon which the correct forms of the teeth depend, and the method of laying out epicycloidal teeth in outside gear.

GRAPHIC REPRESENTATION OF MOTION.

The motion of a point at any instant may be represented in magnitude and direction by a right line.

It is true that the path of the point may be a curve of any kind; but at any given instant it can occupy but one position, and its direction will be that of the tangent to the path at that point. The length of that tangent may, evidently, be made to indicate the velocity; therefore the motion is fully represented.

COMPOSITION AND RESOLUTION OF MOTION.

The *composition* (or finding the resultant) of two motions, is effected as shown in Fig. 1. Suppose the point A, to receive simultaneously two impulses, the motions due to which are represented in velocity and direction by AB, AC. Draw BD parallel to AC, and CD parallel to AB: then AD, the diagonal of the parallelogram thus formed, will represent the resultant motion in both direction and velocity. That is to say, the point A will go to D, in the same time in which it would have reached either B or C, had it received but one of the impulses.

Evidently, if one component and the resultant be known, the other component may be found in a similar manner. If, for instance, we know that AD is the resultant of two components, one of which is AC, draw CD; then the other component must have the direction AB parallel to CD, and its magnitude is found by drawing DB parallel to AC.

The *resolution* of motion is the converse of composition; thus, it is evident that the motion AD in Fig. 1 may be separated into the components from which it was derived, by drawing the parallels DC, AB, in one direction, and DB, AC, in the other; by which the original parallelogram is reconstructed.

But again, AD may be the diagonal of a great number of other parallelograms: from which we see that a given motion may be resolved into two components, having any directions we please to assign.

ANGULAR VELOCITY AND VELOCITY RATIO.

This term *angular velocity* is applied only to circular motion, like that of a wheel revolving on its axis. Every point in the revolving body turns through the same angle in the same time, whatever be its distance from the axis: thus in Fig. 2, the point A goes to D, in the same time that it takes the point B to reach E. Clearly, the arcs AD, BE, represent the *linear* velocities of the moving points; but AD is as many times greater than BE, as AC is greater than BC. If then we divide AD by AC, or BE by BC, either quotient may be taken as the measure of the angular motion represented by ACD; or, in general, we say that

$$\text{angular velocity} = \frac{\text{linear velocity}}{\text{radius}}.$$

If we consider the motion of a revolving point at a single instant only, its direction is that of the tangent to its circular path. In representing it, then, we set off the linear velocity perpendicular to the radius through the point, as AM, BN. Drawing CM, it will be observed that the angle ACM is not the same as ACD. Nor should it be, since the former represents what is happening at a given instant, the latter a motion continuing through a period of definite duration.

The *velocity ratio* of two revolving bodies, at any instant, is simply the quotient obtained by dividing the angular velocity of one by that of the other, at the given instant. If this quotient be the same at every instant, the velocity ratio is said to be *constant*; as in the case of two pulleys driven by a belt which does not slip—if one be half the size of the other, it will always turn twice as fast, whether the actual speed be uniform or not.

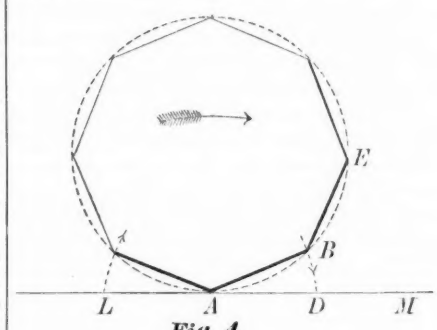


Fig. 4

DETERMINATION OF VELOCITY RATIO.

In Fig. 3, C and D are fixed centers, about which turn the two curved levers CH, DK, which touch each other at A. Through this point draw TT the common tangent, and NN the common normal, of the two curves, and also AC and AD, the radii of contact. If CH turn in the direction indicated by the arrow, DK will be driven in the opposite direction; we now wish to find the angular velocity ratio of the two motions.

The point A of the driver CH must move in a direction perpendicular to CA, and we will suppose its linear velocity at the instant to be represented by AB, which may be resolved into the components AP, AM: the first is the effective component of rotation, the latter being the sliding component.

The point A of the follower DK, must go in a direction perpendicular to AD, and its velocity AL must be such as to have the same normal component AP, the tangential or sliding component being AR.

We perceive, then, that when one revolving piece drives another by contact, the motion is transmitted in the direction of the common normal, which is therefore called the *line of action*.

Now draw CE and DF perpendicular to NN, CD the *line of centers*, cutting NN at I, also CB, DL. We shall thus have three pairs of similar triangles, viz.:

$C\,A\,E$ is similar to $A\,B\,P$
$D\,A\,F$ " " $A\,L\,P$
$C\,I\,E$ " " $D\,I\,F$

Let the angular velocities of the driver, and the follower respectively be represented by v, v'; then since ang. vel $= \frac{\text{lin. vel.}}{\text{radius}}$, we shall have

$$v = \frac{A\,B}{C\,A}, = \frac{A\,P}{C\,E},$$

and

$$v' = \frac{A\,L}{D\,A}, = \frac{A\,P}{D\,F};$$

whence

$$\frac{v}{v'} = \frac{D\,F}{C\,E} = \frac{D\,I}{C\,I}.$$

That is to say: *The angular velocities are inversely proportional to the perpendiculars let fall from the centers of motion upon the line of action.*

Or otherwise: *The angular velocities are in-*

versly proportional to the segments into which the line of centers is cut by the line of action.

CONDITION OF A CONSTANT VELOCITY RATIO.

If it be required that the velocity shall remain *constant*, the second of the values above deduced indicates a condition which the curves must satisfy, viz., they must be of such forms that *their common normal shall always cut the line of centers at the same point.* For the line of centers is of fixed length, whence the segments into which it is cut must always be the same in order to maintain a constant ratio.

Now, the outlines of the teeth of spur wheels must be curves which *will* transmit

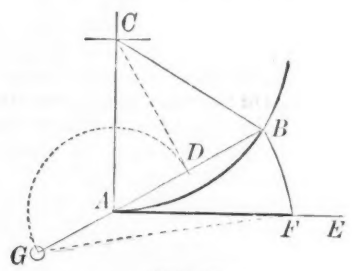


Fig. 6

rotation with a constant velocity ratio, and it will readily be seen that parts of the curved levers in the immediate neighborhood of the point of contact *A*, Fig. 3, might be of the forms proper for teeth of wheels whose centers are *C* and *D*. In the figure, the sliding components of the motions *AB*, *AL*, are respectively *AM*, *AR*; these lie in the same direction, but are not equal; so that at the instant the levers are sliding upon each other with the velocity *RM*, equal to their difference. There would be no sliding if these were of the same length as well as in the same direction; but since the normal component *AP*, is the same for each motion, this can only happen when the resultants *AB*, *AL*, also coincide. And these being perpendicular to the radii of contact, cannot coincide unless *CA*, *AD*, lie in one right line, which must, of course, be *CD*. That is to say, there will be more or less sliding, *except at the instant when the point of contact is on the line of centers.*

NATURE OF ROLLING CONTACT.

The finding of curves which will satisfy the above condition, and also the best means of drawing them, depend upon a feature of perfect rolling contact, best seen by a study of that which is not perfect. The polygon in Fig. 4 rolls along the fixed right line with a hobbling motion; the point *A* is at rest, and the whole figure turns about it as a center, until *B* comes into *LM* at *D*, then about *B*, and so on; the perimeter of the polygon measuring itself off upon the line. If the number of sides be increased, the hobbling will be diminished, and if the number become inconceivable, it will become imperceptible. The broken outline then becomes the dotted curve, tangent to the line, and the change from one center of rotation to another goes on continuously. But this does not alter the facts, that at any instant the point of contact is *at rest*, and that every point in the figure is at the instant *turning about that point of contact as a fixed center.*

DRAWING OF ROLLED CURVES.

In Fig. 5, *AA* is a curved ruler fixed to the drawing board, and *BB* is a free one rolling along it. Let a pencil be fixed to and carried by the latter, either in the contact edge, as at *D*, or at any distance from it, as at *E*. At the instant the rulers are in contact at *P*: therefore the motion of *D* is in the direction *DF*, perpendicular to *DP*, the contact radius. *DF*, then, is tangent to the path of *D*, traced as the ruler *BB* rolls: but it is also tangent to the circular arc whose center is *D* and radius *PD*, consequently the path of *D* is also tangent to that arc. Let the arcs *Pc*, *Po* of *BB*, be equal to the arcs *Pc'*, *Po'* of *AA*, then *cD* will be contact radius when *c* reaches *c'*, and *oD* when *o* reaches *o'*. If, then, we describe, with these radii, circular arcs about *c'* and *o'*, the curve traced by *D* will be tangent to those arcs; and that traced by *E* will be tangent to arcs about the same centers with *cE* and *oE* as radii.

Curves thus described, by points carried by one line which rolls upon another, are called *rolled curves* or *epitrochoids*; and the drawing of a series of tangent arcs as above explained, is the readiest and most reliable method of laying them out. The line which carries the tracing point is called the *describing line*, and the one in contact with which it rolls is called the *base line;* either of these may be straight, or both may be curved.

RECTIFICATION OF CIRCULAR ARCS.

For our present purpose we have to do only with the rolling of a circle, either upon

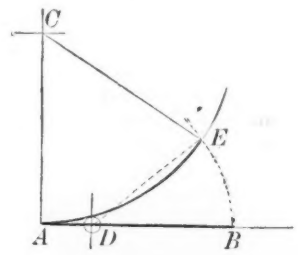


Fig. 7

its tangent or upon another circle, and shall have frequent occasion to set off upon a right line a length equal to that of a given arc, or upon a given circle an arc equal in length to a given right line.

Since the circumference is 3.1416 times the diameter, these operations can be performed arithemetically; but the following graphic process will be found equally accurate and much more expeditious.

I. In Fig. 6, let *AE* be tangent at *A* to the given arc *AB*. Draw *BA*, produce it, making $AG=AD=\frac{1}{2}$ chord *AB*. With center *G* and radius *GB*, describe an arc cutting *AE* in *F*. Then *AF*=arc *AB* (very nearly).

II. In Fig. 7, let the given line *AB*, be tangent at *A*, to the given circle. Make $AD=\frac{1}{4}$ *AB*; with center *D*, and radius $DB=\frac{3}{4}$ *AB*, describe an arc cutting the given circle in *E*. Then arc *AE*=*AB* (very nearly),

Note.—The arc thus rectified or found should not measure over 60°. If the given arc or line exceed this limit, it should be bisected.

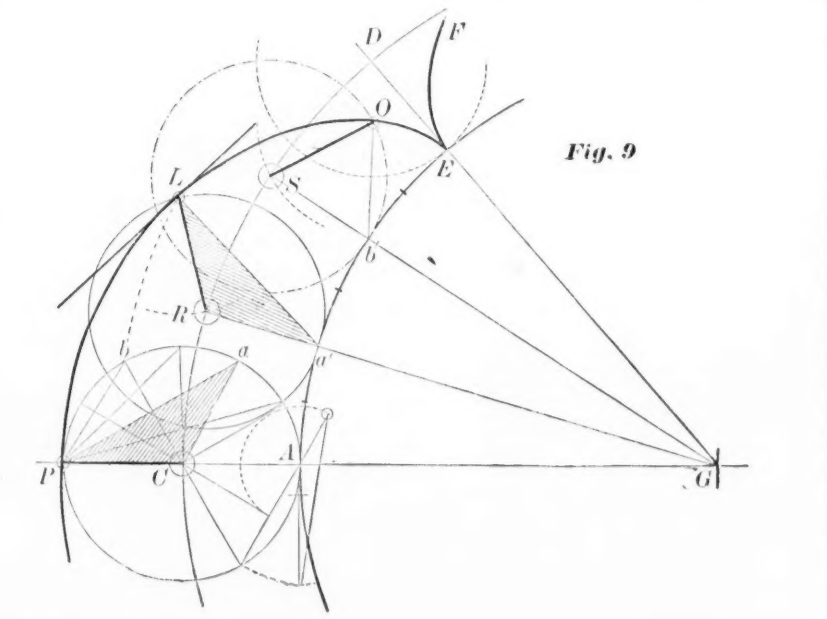


Fig. 9

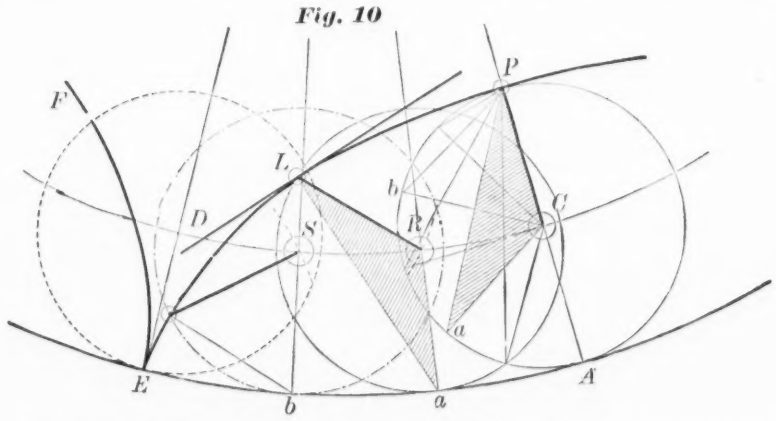


Fig. 10

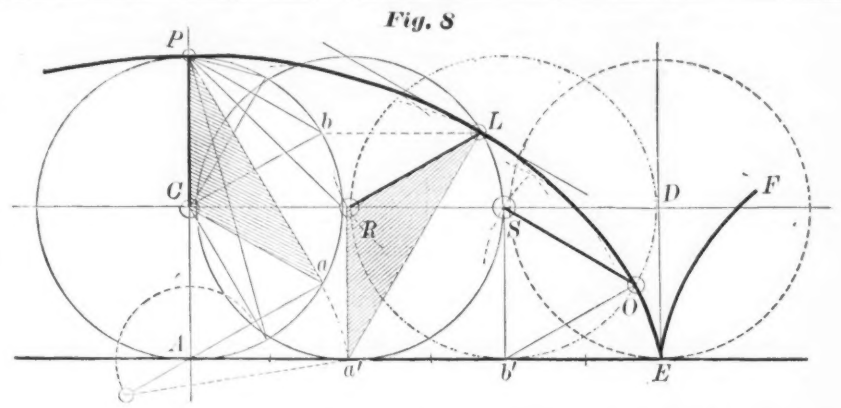


Fig. 8

The particular rolled curves to be used are:

I. *The Cycloid*, Fig. 8. Traced by a point in the circumference of a circle rolling upon its tangent. Find *Aa'*, the length of a convenient fraction *Aa*, of the circumference; step this off the required number of times, making *AE*=semi-circumference. Divide both into the same number of equal parts, draw chords from *P* to the points of division on the circle, with which as radii strike arcs about the corresponding points on *AE*, the cycloid is tangent to all these arcs.

To find points on the curve.—When *aC* becomes contact radius, it has the position *a'R*, perpendicular to *AE*. The angle *aCP*, remaining unchanged, make *a'RL* equal to it: then *RL* is the *generating radius*, and *L* a point on the cycloid. Also *a'L* is the normal, and a perpendicular to it is tangent to the curve at *L*.

Conversely. Let *O* be any point on the curve; about this as center, describe an arc with radius equal to *CP*, cutting *CD*, the path of the center, in *S*. Then *OS* is the generating radius; *SC*, perpendicular to *AE*, is the contact radius, and *b'O* is normal to the cycloid.

II. *The Epicycloid*, Fig. 9. The describing circle rolls on the *outside* of another, whose center is *G*. Draw the common tangent at *A*, set off on this the length of *Aa* (any convenient fraction of semi-circumference *AP*), and find the arc of the base circle equal to that length. Step this off as above, making *AE*=semi-circumference *AP*. The curve is drawn by tangent arcs in the same manner as the cycloid. The path of the center of the describing circle, is, in this case, another circle, whose center is *G*, and the contact radii *a'R*, *b'S*, are prolongations of the radii *Ga'*, *Gb'*, of the base circle, which slightly modifies the processes of finding the point of the curve corresponding to a given point of contact and the converse.

III. *The Hypocycloid*, Fig. 10. Traced by a point in the circumference of a circle rolling *inside* another. Construction in all respects the same as in the case of the epicycloid, and the diagrams being lettered to correspond throughout, no further explanation is needed.

In all three of these curves, if the rolling continue beyond *E*, a new branch *EF* springs up, which is, of course, perfectly symmetrical with *EL*. It is to be particularly noted that these branches are *tangent* to *ED*, and to each other, at *E*. These parts near *E* are the ones which require the greatest care in the construction, as they only are employed in the formation of teeth.

Their fitness for that purpose, and the manner of using them, will be shown in the next article.

Pattern Makers in England.

In the course of a long and interesting article on English Mechanics, the *Boston Commercial Bulletin* refers as follows to the pattern maker:

"The pattern maker is the swell among wood workers. He serves a long period of apprenticeship, and has, moreover to be better educated than most workers in wood. He requires at least a knowledge of industrial drawing and geometry. Pattern makers are largely employed in iron foundries. But they are not a numerous class, and only call for notice because of holding a prominent place among workers in wood. Their work consists in making patterns from drawings furnished by designers. Much of the work is very delicate and requires skillful carving.

The boy who becomes a pattern maker's apprentice is supposed to have a genius for the mechanical arts. Ordinary boys are seldom or never destined for pattern makers, on the principle that it is impossible to make a silken purse out of a sow's ear. The boy who has a taste for drawing and carving, who astonishes his school-fellows by whittling out shapely minature boats and ships and toys, is the boy who is looked upon as the future pattern maker.

In the foundries in which they are employed, the pattern makers rank higher than the moulders and other employés. They receive much better wages, and as less labor than skill is necessary to the performance of their work, affect an air of superiority over their fellow workmen in the same establishment, and, perhaps, justly; for they are, after all, a sort of connecting link between mechanics and the higher arts. They receive excellent wages as journeymen, but the period of apprenticeship is a long and dreary servitude. A pattern maker can always obtain employment, however, for the trade is seldom overstocked with labor, the demand for apprentices being, as a rule, in excess of the supply, and parents who can afford it cannot make a better selection of a trade for a son than that of a pattern maker."

Saturday was a big day at the Buckeye Works in this city, says a recent issue of the Akron (O.) *City Times*. Machine No. 100,000 had been turned out a few days before, and the proprietors determined to have a big time. Work was suspended for the day, all the boys and their friends in this city, as well as at the Canton shops, were invited, and joy was unconfined. The banquet was the biggest affair ever seen in this city, 600 plates being laid, and every seat being filled.

Canadian Mechanics Institutes.

The Minister of Education for the Province of Ontario, says *The National*, has commissioned Dr. S. P. May, of Toronto, a gentleman especially fitted for the task, to enquire into the standing of the different Mechanics Institutes of the Province, and to ascertain if a better method of expending the $30,000 granted them by Parliament cannot be found. The object of the investigation is to see whether the $400 granted to each qualified Institute could not be expended in some way more useful than in the purchase of books. The proposition is, we believe, to establish in connection with the Institutes, schools of practical science suitable to the locality in which they might be started, but not bound down to any particular branch. The amount of the grant to be in proportion to the number of classes, and an extra sum for library and reading room. When this system is properly established, scholarships will be offered, and the winners entitled to admission to the School of Practical Science at Toronto. By this means it is expected a vast amount of good will be done to the young men of the Province. It is also proposed that every Institute shall form a small museum. The affiliation of the several Institutes is also a part of the scheme, so that members of one branch visiting another would be entitled to all the privileges of membership in a strange place for a certain time, by presenting a ticket from his own Institute. This would prove a great boon to the traveling portion of the community. According to Dr. May, it is the wish of the Government to raise the standard of the Institutes, and not allow them to be mere circulating libaries for works of fiction, as unfortunately too many of them are at present. The higher education of mechanics is a necessity in this age of progress, and the Minister of Education, in thus taking hold of the subject, is entitled to the thanks of those who wish to see the Institutes flourish as they should.

Louisville Industrial Exposition.

Louisville opens her Eighth Annual Exposition on Tuesday, the 7th of next September, in the grand building erected for it on the corner of Fourth and Chestnut streets, and will continue open daily, Sundays excepted, until Saturday evening, October 23d.

There are 17 cotton factories in South Carolina, and their business is 25 per cent. better than it was one year ago, it then being remunerative. All new machinery put into a factory in the state is exempted from taxation for ten years. The number of operatives employed is 2,296, and they are paid on an average $18 a month for 12 hours a day.

How to defend oil tanks from lightning is a question of paramount importance just at this time. Vast amounts of property have been destroyed this season through the ignition of the oil by lightning.

The Health Department of Chicago has found that there are in the 2,311 factories of that city 43,632 men and boys, and 9,362 women and girls, many of whom are in a very bad sanitary condition.

The annual Convention of the Firemen's Association, State of New York, will be held in the city of Auburn, August 17, and continue in session for three days.

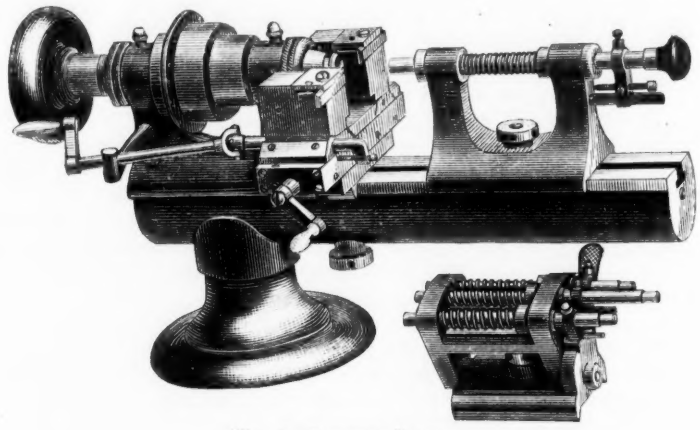
The water in Philadelphia is so bad that the *Times* of that city says: "Every person who takes a bath is obliged to take another to wash the mud off."

Educate your boy to be a railroad brakeman. There are seven United States Senators who started life in that line of business.

Watch Making Machinery.

The remarkable increase in the manufacture and sale of American watches is having its natural effect in stimulating the ingenuity of the men who make the tools with which the watches are made. This, in turn, by introducing new and valuable labor-saving devices, tends to enable the watch-making companies to produce better and more accurate work at a lower price, and to swarm upon the watch-buying public in the lively way that brings trade and prestige.

One of the latest competitors, for the confidence and patronage of watch and clock-making companies and of jewelers and watch makers and repairers generally, is the Sawyer Watch Tool Company, of Fitchburg, Mass., a number of whose tools are illustrated herewith.



No. 2. Sawyer Lathe.

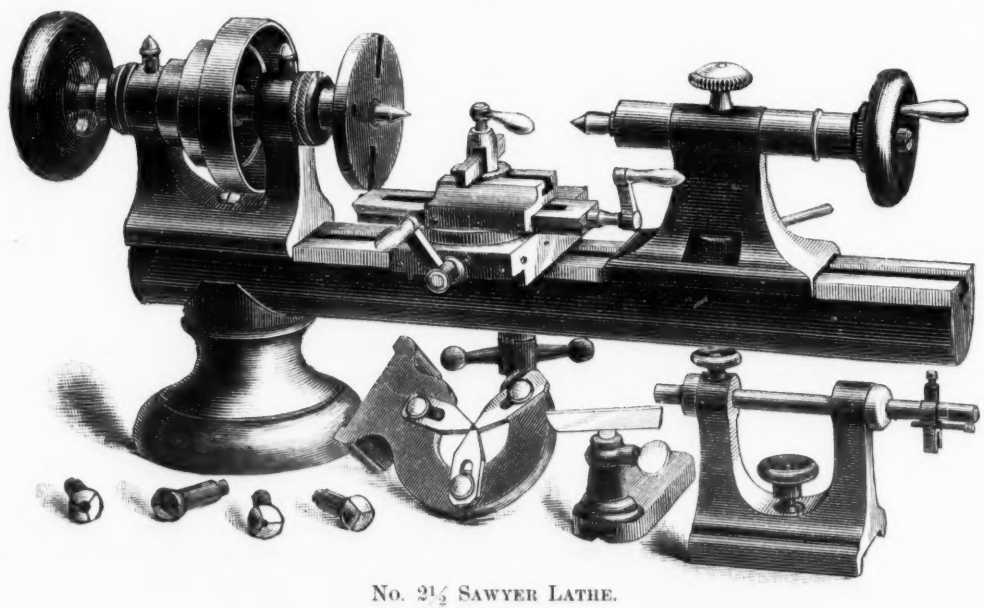
The two lathes shown in the cuts are such as will be readily understood without special description, being also adapted to the wants of amateurs, model makers and others. In placing these lathes upon the market an attempt has been made to offer a closely made and perfect lathe that will do a great variety of work; two sizes, Nos. 2 and 2½, being judged sufficient to be shown in this connection. In all the lathes made by this company, the hollow spindle and spring chuck are used, such as are in general use in all the watch factories in the United States. Double taper bearings, made of hardened steel, are also a feature in the construction of these tools.

The pinion cutting engine, shown in the cut, is designed for cutting the teeth in small pinions. It has a revolving head with three spindles, each spindle running in a quill or shell, made from the finest steel, hardened, and has double taper bearings. The spindle is also of hardened steel, ground to fit the quill, has a fine combination of adjustments, and can be set with great accuracy. On the back end of each spindle is a gear. In revolving the head the driving need not be stopped, as the gear on the end of the spindle will connect with the driving gear while in motion, which facilitates the working of the machine and adds to its daily production.

The automatic leaf polisher is designed for polishing the leaf or teeth of pinions. It can be set to make so many strokes a tooth; it also can be set to polish so many teeth (or as many teeth as may be in the pinion), and not run by and polish one tooth the second time, which would cause an imperfection in the pinion. It rotates the pinion itself, that is, as soon as a tooth is polished, it turns the pinion around to the next tooth, and is arranged to plane the form on the polisher without removing it from the machine. It has all the necessary adjustments for its particular use.

The automatic staff and pivot turning machine is designed for turning staffs and pivots, and is capable of doing a great amount of work. It can be adjusted to produce staffs and pivots in quantity of exact size. The machine will do the turning while the operator is preparing another piece of work to put in it, and the process is repeated. Every staff is turned upon dead centers, thereby insuring them to be perfectly true. It can be set to turn straight or taper, and to square up the shoulders, and has every adjustment necessary to facilitate its working, and produce accurate work at a very small cost.

A narrow gauge railroad of 21½ inches is contemplated for the lumber districts of Quebec. It will cost some $2,500 per mile.



No. 2½ Sawyer Lathe.

Letters from Practical Men.

FOLLOWERS IN SMALL STEAM ENGINES.

Editor American Machinist:

I would like to be allowed the liberty of saying just a few words about the construction of solid followers in small vertical steam engines. In the first place, we are all, or nearly all, willing to agree that for these the solid follower is superior to all others, and we also know that there are some serious objections to them that have greatly reduced the number used, and these are: First, the decrease in size from wear, leaving too much space between the cylinder and follower, thereby causing an increase in the steam used to do the same work; second, the follower, in that loose condition, will, when the steam enters the ports, jump to one side of the cylinder, making a noise like knocking, and this has often led the man in charge to tighten up connecting rod and main shaft, until hot boxes was the result. Now, let us see what we can do to overcome this trouble where it already exists, and provide against it in new work. What I am about to suggest as a remedy for the knocking, caused by a worn follower, is just what I have made a matter of experiment and found to be a success. I will give my experience.

I was using a small vertical engine of two horse power that had been in use about four or five years, and I was continually annoyed with the knocking above referred to, and on examination of the cylinder and follower I found there was just enough play between them to make a noise, if the follower was moved very rapidly from one side to the other. Not having time then to fit a new one, I took the old one to the lathe and turned two grooves in the circumference of it, ¾ of an inch from each end, and ⅛ deep and ⅛ wide; then I drilled a hole ⅛ inch in each end of the same, near to each edge, so when the steam entered the cylinder it would fill the little groove and act as a cushion. I put the engine together again, and the trouble was over. It now runs without any noise whatever. I do not want to advance the idea that I have reduced the quantity of steam used for the same work, but I do think, if it will keep the follower from rubbing the sides of the cylinder, so much as to stop the noise, it would increase the durability of a new follower to a considerable extent. I would like to hear from some older men in the business that have had more experience than I have.

Yours very truly,

Croton Falls, N. Y. W. S. Harris.

ON THE ADHESION OF BELTS.

Editor American Machin'st:

In your issue of July 17, Mr. Rose gives many judicious "thoughts about belts," which are altogether pleasant to find, and when found, very profitable to read. In the after part of his "thoughts" he quotes the following from one of my articles in a Boston paper:

"It is very true that if the belt does not touch the pulley it cannot pull it around, nor can it be driven by the pulley. It is also true that if belt and pulley touch on a limited area only, each can drive the other with a force but a part of what it is capable of doing; and it is only when contact is made perfect, that is when every square inch of the belt, so to speak, is down solid on the pulley surface, which surface we will grant is very smooth, that the greatest driving effect is obtained,"

And then asks, "whether this fact leaves out the theory that the friction is as the pressure, and independent of the area of contact?"

In the first place, Mr. Rose's thoughts on belts are nearly the same as those he has quoted from me. He says in this same article: "The transmission of power of a belt varies, all other elements being equal, upon the amount of friction between the belt and the pulley surface; furthermore a given belt will not transmit as much power to a roughly turned, as to a smoothly turned pulley. And from these facts I am firmly of opinion that the area of contact as well as the arc of contact is an important factor in the transmitting power of belts. Indeed, it is an acknowledged fact that a belt will drive more with the grain than with the flesh side to the pulley."

All of this quotation goes to show that there exists some sort of a relation between the area of contact and the driving power of a belt. I could quote pages from "Use of Belting"—my notes on the means of transmitting power—from first class engineering sources to prove the same thing.

If this can be done, then the laws of friction as given by scientific authorities will have a hard time of it when put to the belt test.

But, seriously, are we not mixing things a little? The *adhesion* of belts, and the *friction* of clean prepared surfaces are two different things, and different conditions of things.

It ought to take, and it does take, the same power to pull a brick over a level surface,

whether we drag it on end, edge or side, when all surfaces are clean and alike, and yet the areas of contact are as 8, 16 and 32 respectively.

Therefore, I can quote Morin: "The experiments made by me upon the friction proper of plane surfaces upon each other comprise 179 series, answering to different cases, according to the nature or condition of the surfaces in contact; and they all, without exception, lead to the following results:

The friction during motion is—

1st. Proportional to the pressure.

2d. Independent of the area of the surfaces of contact.

3d. Independent of the velocity of motion."

His "experiments upon the friction of strong leather, tanned and placed flatwise upon cast iron," are included in the series. "Though leather is a soft and very compressible substance, its friction is none the less proportional to the pressure, and independent of the velocity throughout the whole range of the experiments."

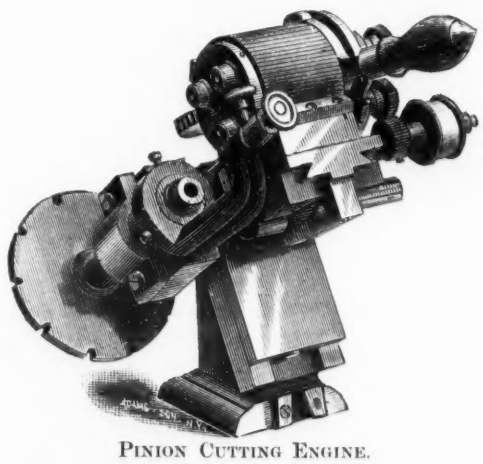
The reader must notice that Morin's experiments were made for ascertaining the friction "proper" of surfaces on which *unguents* were or were not used, but not *adhesives*, and hence we find him saying: "If the surfaces were great and the pressures very slight, the viscosity of the unguents, usually disregarded, might then exert a sensible influence."

The driving power of belts, therefore, may properly be considered as cases of friction where iow pressures and comparatively large surfaces are involved, and in which friction is augmented by viscous unguents or adhesives.

If this be admitted, then we must pass from those conditions in which the laws of friction are developed to another condition where adhesion preponderates over sliding, in the consideration of which new laws must be established.

Practically, we will find here just what all believe, that the area of contact is an important factor in the problem—that two square feet of adhesion will hold exactly twice as much as one square foot. Not so with friction, which is as the pressure, not as the surface.

Mr. Rose further quotes:—"The atmosphere does not press two bodies together when it can get between them; it is only when excluded by a tight joint that the development of its pressure is possible, and it



PINION CUTTING ENGINE.

becomes sensible only when an effort is made to separate them by a force acting at right angles to the plane of their faces."

This is only another way of saying that a body is in equilibrium when the atmosphere has free access to all sides of it.

Are not his surface plates in equilibrium when the film of air is between? And if in equilibrium, are they not pressed together by gravity *alone*, supposing one plate rests upon the other? Does not the top plate slide very freely over the under one when the film of air is between? And is not resistance offered *only* when effort is made to separate the plates?

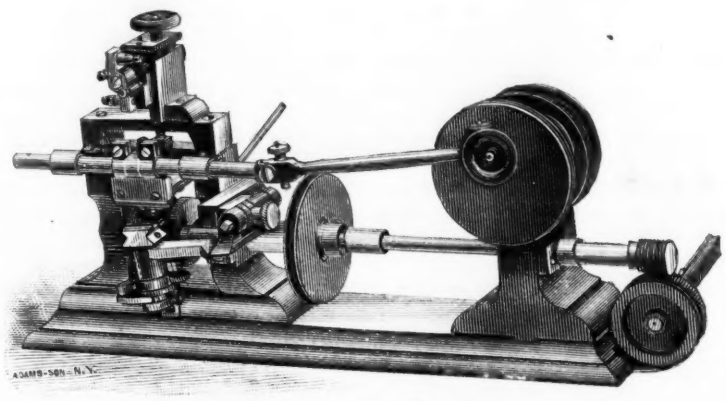
The quotation, on analysis, will answer these.

But Mr. Rose asks of his surface plates: "With a film of air between, what holds the bottom plate up?"

I suggest, an action of near contact, like capillary attraction. The chemists call this Catalysis, applying the name to a force or action exerted by one substance upon another when they are brought together, by which new phenomena are developed, not shown and not possible by either alone.

There is an unexplored field here open for investigation. "No plausible theory has been brought forward to account for these actions or to define what the force of catalysis is."

J. H. COOPER,
135 Wister Street,
July 12, 1880. Germantown, Pa.



AUTOMATIC LEAF POLISHER.

FROZEN NITRO-GLYCERINE.

Editor American Machinist:

In your issue of July 24th, I notice a few words on nitro-glycerine. You state that at 40° *Fahrenheit it becomes an icy mass which merely requires friction to explode.*"

This, allow me to say, is not a fact. When nitro-glycerine becomes an icy mass it was found by Prof. Mobray to be next to impossible to explode. He went so far as to place gun powder on a frozen mass which was exploded, leaving the nitro-glycerine intact.

I am yours truly,
W. D. FORBES, M. E.

Editor American Machinist:

In your issue of June 12, on page 9 an answer to queries 5, question 2 reads as follows, "Why is it that a piece of solid iron will float on a ladle of molten iron?" You reply that a body in a liquid is buoyed up by a force equal to the weight of the liquid it displaces.

The above cause has something to do with it, and largely, perhaps, but a clean, round sphere of cold iron will sink to the bottom of a ladle of moderate size, the sphere being, say, 2" diameter, and a ladle 2 feet deep. It will soon rise while the same or similar sphere red hot, but still solid, put in under the same conditions, will not be under the surface so long, showing it does not sink so deep. The reason of this, I conclude, is that the cells occupying the interior of the ball being filled with air the heat causes the air to expand. It buoys and helps to lift the load as a hot air balloon. But the cold sphere of iron goes down to find a place to rest until the air becomes heated; when it changes its course it will come up like a cork.

Question 4 reads as follows, "Is there more carbon in hard cast iron than in soft?" You answer, yes, which answer does not seem to me to correspond with what I have read and observed. Hard iron contains no greater or very little more carbon than soft iron, but in a different state. In hard iron, carbon is in combined form, while in soft iron it is uncombined or in the graphite.

Scotch pig is rich in graphite, so is the American Scotch pig. To illustrate this take a chilled car wheel where there is a film of chilled or white iron at the rim or periphery. Is there more carbon at or in the chilled portion than in the hub of the wheel? I think not. It has been changed through the process of chilling from uncombined to combined carbon.

This is my view. Am I sound or defective in this conclusion?

L. C. JEWETT,
June 7th, 1880. Dayton, Ohio.

RAILROADS OF TWO FEET GAUGE.

Editor American Machinist:

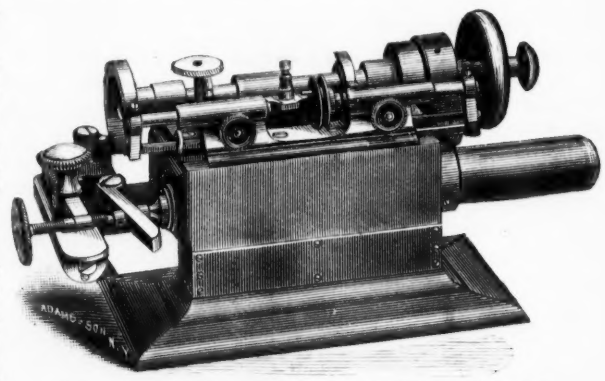
Having recently had the pleasure of a ride from Farmington to Phillips, Me., on the Sandy River railroad (narrow gauge), I can say that it far surpasses my expectation in the easy and steady motion of its cars. Though the road bed, being new, has settled in many places, and is therefore rough, the cars ride fully as easily as those of the broad gauge. The speed is necessarily very much slower, making the time between F. and P., a distance of 18 miles, in 1 hour and 15 minutes. The power of the little locomotives is almost surprising when a machine of 7 tons is seen drawing its load of 7 cars, filled to their utmost capacity to the number of 450 passengers, over steep grades and around sharp curves.

It is a matter of congratulation to the people of that section of country that the road is such a success, and much credit is due Mr. Mansfield for his energy in pushing the enterprise through. I understand he has a call to superintend the construction of the Skowhegan & Athens road in same State, the capital stock of which has been fully subscribed, and will probably be running before another year rolls round.

It is probably only a matter of time when these narrow gauge roads (2 feet in preference to 3) will be known as the most important factors and feeders of the standard roads through out the country.

I would advise any one interested in the working of such a road, and especially if he should have the good fortune to get a vacation these busy times, and is fond of the lighter sports, such as fishing and hunting, to visit the Rangley Lakes, *via* Farmington, Me., and from there take in the narrow gauge to Phillips. The country, through which this road passes, is one of the finest in New England.

F. H. MORSE.
1176 Tremont Street, Boston.



AUTOMATIC STAFF AND PIVOT TURNING MACHINE.

ANOTHER DESTRUCTIVE STEAM BOILER EXPLOSION.

Editor American Machinist:

This is the title of a circular letter sent out by a boiler insurance company, and its contents show that it is intended as an advertisement of their prompt payment of the loss from the explosion.

This is right enough, as far as the commercial character of this company goes, but what about the cause of the explosion? I take it that all boiler owners would not be satisfied with having their policies paid without an investigation into the cause of the accidents, and doing all in their power to prevent their recurrence. From the tone of that circular, one would imagine the ultimatum of boiler insurance is simply to make good the money loss, and that the lives of men and the support of their families is a matter of secondary consideration. Why should there have been an explosion? That is the question. Explosions are not produced by witchcraft, or even the "visitation of God," as they were thought to be at one time; and engineers, especially, know that there is no effect without a cause. If, in our search for a cause, we cannot find it, then it is because of our ignorance or prejudice in old-time theories, such as low water (when there is no evidence of it), decomposition of steam into its constituents: oxygen and hydrogen; electricity; and many other notions which theorists have set up among themselves, rather than admit that part of a structure was too weak to resist the stress put upon it.

"The benefits of steam boiler insurance demonstrated," is the next sentence of that circular, and we find from it that on the 10th of May a steam boiler exploded, killed three men and made considerable havoc otherwise, notwithstanding the boiler was "thoroughly inspected ten days previously," and found "in first-class condition," this being "verified by the experts at the Coroner's inquest." "Which was to be proved," written after this, would remind one of the comic writer who proved by logic that a pigeon was an eel pie.

The opinion of the writers of the circular is, that "we think the explosion was caused by low water." Now, why *think* so? Could not the experts on the Coroner's inquest have verified this point, as well as the fact of the boiler being in first-class condition? There must have been some evidence of overheating, which to an expert, would be as plain as a page of a book.

If this circular had given the cause of the explosion, as arrived at by the testimony of competent experts, there might have been some benefit in sending it round, so as to enlighten people in what way a boiler may explode, although it be "in first-class condition." Boiler insurance should be a little different from this. The following is from a circular of an English company, and, I think, embodies quite a different principle from the above.

"This association was founded by———, for the purpose of preventing steam boiler explosions by competent periodical inspection, *in order to save human life.* Not a *single person* has been killed or injured by any guaranteed boiler; whilst outside the ranks of the association, during the past ten years, 619 people have been killed and 1,018 others injured."

The late Zera Colburn says: "All our knowledge of boiler explosions goes to show that * * * in the majority of cases the actual explosion results from some defects either original or produced, and either visible or concealed, in the materials, workmanship, or construction of the boiler." As this has been proved to be true by the great mass of evidence accumulated during many years, by the Boiler Inspection and Insurance Companies of Europe, and also by those in this country, it behooves every-one interested, more especially Boiler Insurance Companies, to find out these defects. Again, Colburn says: "Probably not more than one per cent. of all steam boilers made, ever explode at all." If this is true it leaves plenty of margin for an insurance company to make a good thing of it, at the rates charged, and to amply repay them for investigating and inspecting, even if they did not reduce their percentage of explosions to that of the abovementioned English company.

DAVID N. MELVIN.
Lincoleumville S. I., N. Y.

In the prisons of the state of New York there are 2,000 convicts employed at stove moulding and hollow ware.

Hewet's Pop-Valve.

The accompanying engraving represents Hewet's patent "Automatic Lock-up Gauge Safety-valve."

Fig. 1 is a sectional view, *J* being a valve-seat, fixed on the dome head by bolts at *KK; LL*, parts with face of seat on either side; *MM*, valve having an outer and inner discharge, as indicated by arrows 1,1, 2,2; *N*, a valve-post firmly fixed to the seat with nut *O*, and provided with a thread at *X*, for set and jam-nuts. *Q*, is a step and *R*, a cap, made to conform to the spiral shape of the spring for one entire coil at each end, to prevent its getting out of line, and to keep the valve from binding. The tubes *S* and *T*, fastened to the step and to the flange *U*, and moving with the valve, are intended as a cover to the spring to prevent tampering with the valve, and to exclude dust. *V*, is a set nut for regulating the pressure; *W*, a lock-up cap with lock and key at *Y*.

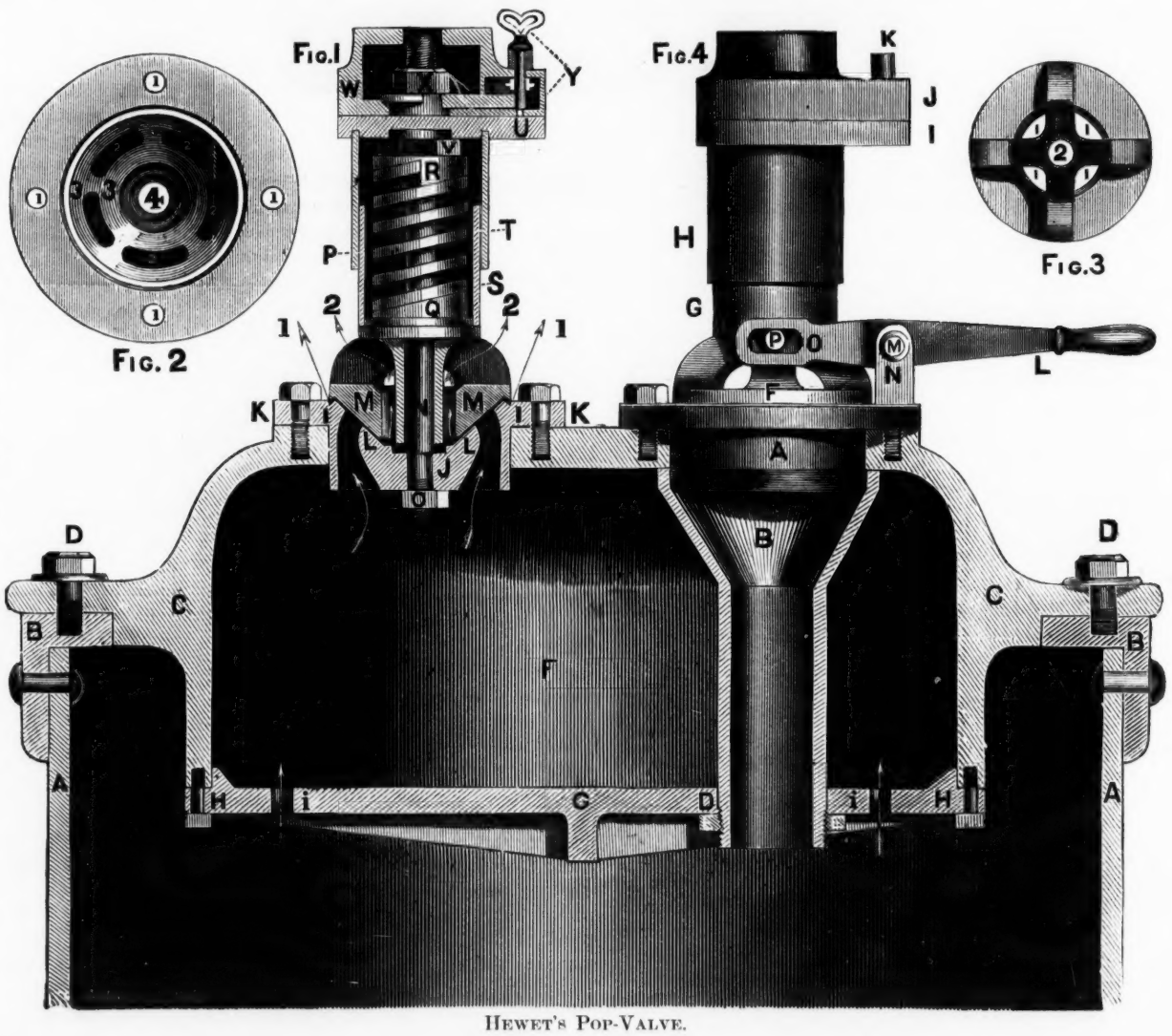
Fig 2 is a top view of valve-seat, 2,2 being steam-posts; 3,3 conical seats for the two valves.

Fig. 3 is another top-view, showing the upper and inside valve.

Fig. 4 is a perspective view of a supplementary or reserve valve, which principally differs from Fig. 1, in having a tube—shown in section at B—extending through the ante-chamber *F*, directly into the boiler; and in having a handle *L*, with which steam may easily be blown off by hand when desired. The handle is forked, and has a slot in each branch for holding a pin to work in the holes *P*, of the valve.

The ante-chamber *F*, is not indispensable to the correct working of this valve, but it enables the boiler pressure to remain more constant at all times by preventing excessive discharges. The ports *i, i*, have a less capacity than those at 1 and 2, Fig. 1; and, therefore, when the valves begin to act, the impact of the steam causes it to blow off till the pressure is less in the ante-chamber than is required, but not so much less in the boiler.

The advantages claimed for this are: It is simple, and, therefore, but little liable to get out of order; it has a double outlet, thus giving it great capacity, and allowing it to discharge more rapidly; it is noiseless in its action; it uses less than half the spring power required by some others, making it more delicate in adjustment. It does not foam, and will, therefore, not throw water. This valve is being introdued by Champion & Spencer, Chicago, Ill.



A German has invented a contrivance for lubricating loose pulleys that is somewhat analogous to Prof. Sweet's device for oiling his Straight Line Engine shaft. A circular box is shrunk on the boss of the pulley, carrying on the inside three small paddles which dip up the oil placed in the bottom and let it run down through holes in the boss. This is particularly adapted to weaving machinery and other places where oil should not drip.

The Atchison, Topeka & Santa Fe Railroad has obtained a grant from the government of Mexico for a line about 400 miles long, passing through Sonora and terminating at Guaymar on the Gulf of California. This road when built will shorten the route from New York to Sydney, Australia, from 7,400 to 6,000 miles.

Shop Cleanliness and Order.

BY J. E. WILSON.

We nowhere see more fitly exemplified the truth of the proverbs, "Cleanliness is next to godliness," and "Order is Heaven's first law," than in the management of the modern machine shop.

Cleanliness and order are most important fundamental factors in the economy of the workshop, for without one the other cannot exist.

Cleanliness begets system, and without system the full measure of success, either mechanical or financial, or even spiritual, will not be realized. This may be stating it "strong," but the position can be sustained.

If the mechanic will consider that more of his time is passed in the shop than in social intercourse with his family or friends, he will see how inconsistent he is to allow any less degree of cleanliness and order to reign in his shop, than he would countenance in his own household.

But it is of its utility, as an element in the successful management and conduct of the machine shop, that I wish to speak. A few years ago, while visiting a shop where about 30 men were employed, the question was asked of the foreman—who was up to his eyes in gudgeon grease—"Why don't you pick up your tools and clean up the shop and machines a little?" His answer was: "O, we haven't got no time to clean up. Our business is to make machinery; besides, we *do* clean up every Saturday night." A year later, having occasion to visit the same shop again, the old landmarks had disappeared; a transformation had been wrought; over 100 men were now employed; the shop and machinery were clean and bright; the atmosphere had changed and was as pleasant and congenial as a parlor, notwithstanding the usual noise.

We inquired for the foreman and he came forward from among the men. But, as he came, he called the attention of a boy to a turning tool which had fallen under his lathe, and that movement disclosed the secret of the whole thing. It is needless to say that he was a new foreman, whose strong point was order, and the whole tone of the shop, and character and quality of the work bespoke it.

"Now, of what practical utility was this change, allowing that there was no difference in the mechanical ability of the two foremen?" may possibly be the question of some one who is conscious of deficiency in this regard. In the first place clean machines are always in order; consequently, better work can be done on them, and they run with less friction—an item in the coal and oil bill. Tools are in their places, there is no loss of time hunting them up, hence, economy is insured in the cost of labor on a given job, for no job should be charged with the cost of hunting for tools which were used on a previous one.

Besides, there are many other advantages to the men themselves, such as less wear and tear on clothing (which works itself out at the wash tub), increase of self-respect, stimulating ambition, etc., all tending upward, demonstrating the truth of the godliness of cleanliness, and putting more dollars into the pockets of all concerned. It is all the more profitable because it costs nothing. Modern machinery is so largely automatic that there is an abundance of time, while cuts are making, to wipe off surfaces not in proximity to running parts. The bench workman will do more work, if his bench is clean, than if he had to handle over a dozen tools before finding the one wanted. Racks and shelves are a thousand times better than chests or drawers for holding bench tools, and no more labor or time is involved in putting up a tool at once after use than at any other time.

The apprentice should be taught that cleanliness and order are the first necessary adjuncts to mechanical superiority and success, and that without them his services will depreciate in value, no matter how good a workman he may become.

It may seem late in the day to press points which are so largely recognized and self-evident; but a little observation will reveal a strange disregard of them among those shops considered first-class. Their offices will be found fitted with elegant furniture and every convenience; artistic letter and bill heads and everything betokening fine taste, culture, and perfect adaptation of means to ends. Not a speck of dust is visible, or even a penholder out of place. The system of accounts is the best the schools and experience afford; order reigns supreme, and there could be nothing more desirable. But enter the machine room! Are the same principles there in force? I venture to say—and it is from somewhat extended observation—that this is the weak point with ninety per cent. of them. The exceptions are greater lights among the lesser, and may be known by the character of their work, their workmen, and the size of their dividends.

If the schools, about which the veteran mechanics know but little, would place the importance of these things before their students, they might accomplish nearly as much for the advancement of the arts as by their mechanical training.

In answer to a query, a contributor to the *English Mechanic* says: "Most of the towns in the New England States manufacture machinery; the leading seats of that industry are New York, Brooklyn, Jersey City, Newark, Paterson, Philadelphia, all close to New York City. Bridgeport, Norwich and New Haven, Connecticut; Providence, Rhode Island; Worcester, Boston, in Massachusetts, and an infinity of towns in the Eastern and Middle States; the foregoing, however, are easy of access, and should suffice. 'J. A. A.' must be prepared to work very much harder in the United States than he would at home, but for much higher wages, and during a less number of hours. If a young man, by all means go; but if, say middle-aged, he probably will never get over his prejudices, or be reconciled to the great change from old-world notions; let him, on arrival, go to the libraries and news rooms which abound, and he will soon get posted."

The Sedalia, Mo., Industrial and Art Association will hold its annual exposition and fair at Sedalia, beginning on Tuesday, September 14th, and continuing five days.

Management of Marine Engines—Economical Speed, etc.

BY ALFRED R. WOLFF, M. E.

It has been generally accepted as a close approximation that the resistance of a vessel varies directly as the square of the speed. Experiments in England in the past few years, especially those conducted by the late Mr. Froude, F.R.S, indicate that this adopted law does not hold true, especially at high speeds. The rate of resistance decreases as the rate of speed increases, owing principally to the rising action of the vessel at high velocities, so that assuming the vessel to have nearly infinite velocity it would almost skim along on the surface of the water, and while the resistance to the progress of the immersed portion would increase directly as the square of the speed, the portion immersed would be less than at a low velocity, and therefore the total resistance would vary in a lesser ratio than the square of the velocity. However, for all practical purposes, at the moderate speeds now used in steam propulsion, the old laws of Rankine and Scott Russell may, for the present, be accepted as correct. Since the power required to overcome a resistance

is measured by the product of the resistance, and the velocity with which it is overcome, and the power of an engine is considered to be a direct function of the fuel consumed, the fuel consumed in a vessel is accepted as varying directly as the cube of the speed. This has led some writers, notably King in his book: "Notes on the Steam Engine," to assume that the slower the speed the more economical the consumption of the fuel to traverse a given distance. This, however, is not the case; for, besides the resistance of the vessel, the engines and boilers as independent mechanism deserve their due attention, and for every particular boiler and engine (considering it independent of the vessel) there will be some power speed or conditions of running for which the consumption of fuel per horse power will be least. So that in a given steamer, of which the boilers and engines are correctly designed for a high power and speed, it will be more economical, as far as the machinery alone is concerned to run at a high speed, while, as far as the hull itself is taken into account, it would be more economical to run at a slow speed, so that there will be a mean between the two, at which speed the vessel considered as a whole will run a given distance with the smallest consumption of fuel. This economical speed will vary with each vessel, and it becomes the duty of the engineer to determine it at different times by observation and experiment. Usually in ocean travel, other considerations cause economy of fuel in the sense here described to be of secondary importance, but since occasions of lack of fuel, and others may arise, which will make economy of fuel a primary consideration, the engineer should at all times be acquainted with the most economical speed of his steamer. In government vessels, with limited bunker capacity, on long cruises, speed is frequently of no importance, and an economical consumption of fuel becomes the sole desideratum. In the United States Revenue Marine Service an order had been issued with a commendable view to the economical use of fuel to run the steamers at a speed of eight knots per hour in ordinary cruising. The writer was engaged for a long time in working up the results of the runs, calculating the performance of the vessel and the machinery of the revenue steamers, taking all possible conditions into consideration, and it was found that while in some vessels it was more economical to run at seven and less knots per hour, in others—whose machinery was designed for maximum power—nine and more knots per hour gave a far superior performance to eight knots and under. This consideration of the most economical speed has not received the attention it deserves in the merchant marine, and the system of observations and records adopted in the United States Revenue Marine Service is well worthy of careful study and imitation.

SLIP OF PROPELLER.

The amount of slip of the propeller is a "point" that the engineer should be able to ascertain quickly. The "slip" is the difference between the distance traveled by the screw and the distance traveled by the vessel in a given time, and is usually expressed in per cent. of the speed of the screw. The distance passed over by the screw per hour, expressed in knots, is equal to its pitch × revolutions per hour ÷ 6080. The speed of the screw can be determined approximately in a short time by multiplying the pitch (in feet) by the number of revolutions per minute, and dividing by 100, since revolutions per hour = revolutions per minute × 60 and $\frac{60}{6080} = 1 \div 101\frac{1}{3}$ or nearly $\frac{1}{100}$.

INDICATOR CARDS.

Every marine engine should be supplied with an indicator, and the engineer should be required to take a card at least once every 24 hours, or better still, once every watch. These cards, by inspection, become the test of the action of the valves, and by calculation, the determination of the power of the engines and the means of ascertaining the quantity of coal consumed per horse power per hour, all important data to secure an economical and satisfactory working of the marine engine.

FUEL.

In the selection of fuel the peculiarity of the boiler should be taken into account; fuel of small cost may prove expensive to burn in one boiler, and fuel of great cost inexpensive in another form of boiler. Fair and intelligent trials of different kinds of fuel will soon determine the most economical to use, but where the boilers and engines of various steamers of a steamship line differ materially, one quality will usually not be found advantageous for all the vessels, and each steamer should be supplied with that kind of fuel best adapted to its boilers.

The firemen should be obliged to keep up a given pressure of steam while running under known conditions, with the number of buckets of coal per hour allowed by the engineer. The lowest permissible limit of pressure should be that which good firemen have readily attained upon the vessel. If an inferior fireman does not at first come up to this limit, constant supervision on the part of the engineer, and correct suggestion as to the handling of the fires, will soon cause this limit to be reached.

A New Vise.

We present herewith an engraving of a new vise, which is capable of being placed and secured in any desired position to adapt it to different kinds of work, and to hold it in a convenient position for the workman. The lower end of the fixed jaw is provided with an arm projecting backward, and having a spherical socket for receiving a ball on the end of a fixed standard. The spherical socket is made in two parts, one being an integral portion of the vise, the other being secured to it by screws, and the two parts are capable of being drawn tightly down upon the ball by a clamp screw passing through one part into the other.

NEW BENCH VISE.

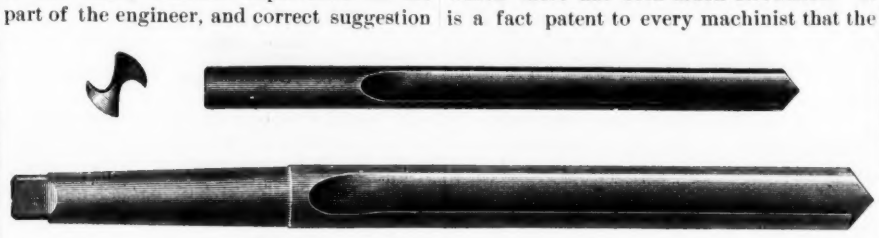
In the lower end of the fixed vise jaw there is a socket for receiving a standard having a convex foot, which rests on the bench which supports the vise. The standard is adjustable, and is held in place by a set screw. When the vise is set in any desired position the standard is drawn out until it bears upon the bench or table, and assists the ball and socket joint in sustaining the weight and strain of the vise and work.

The inventor of this new vise is Fortonato C. Zanetti, Bryan, Texas.

The New Universal Lathe-Drill.

Within the past twelve years much has been written on the subject of drills; and during this period experts and practical mechanics have been critically testing the various productions of this description that have been brought to their notice. It is a well-established fact that no one drill is equally well adapted to all descriptions of work. The twist drill has perhaps held a leading position; but even this has not come fully up to the required standard of perfection and adaptability, its range of work being necessarily limited. In drilling holes of considerable depth, and when the metal drilled is of uniform density, free from seams, and blow holes, (particularly in vertical drilling) the twist drill has no superior. But for the rough wear and tear of the machine shop, and in the hands of apprentices and inexperienced workmen it is an expensive tool.

The angle of the lip, too, is a matter over which there has been much discussion. It is a fact patent to every machinist that the old-fashioned flat-forged drill holds its place in every machine shop, and simply for the reason that the acute angle of the lip, and the thin edge of the twist drill, and its tendency to "draw in" are defects too serious to allow the former to pass into oblivion. And yet the twist drill is a tool that has come into very general use, not on account of its merits solely, but also because heretofore it alone has even approximately met the wants of mechanics, in respect of variety of sizes and styles made, and facilities for obtaining them.



THE FARMER UNIVERSAL LATHE DRILL.

The Farmer Lathe Drill and Tool Company have been making practical tests for over two years, and the result is that they are now placing upon the market a patent universal lathe drill as shown in accompanying cuts. It is intended that it shall work its way into favor in machine shops upon its actual merits, particularly in shops working copper and brass. This drill is intended for the lathe, and to be used where the rank cut of the twist drill fails to work satisfactorily; and, although it can be put to many uses not usually expected of a drill, yet they do not claim that it will do impossibilities—such as drilling chilled iron, hardened steel and the like.

It can also be advantageously used in the drill press, provided sufficiently high rates of speed can be obtained. The following advantages are claimed:

This drill can be used both as a rotary and as a chuck drill; hence the name "Universal." It can be used for counterboring, slotting, reaming, drilling out irregular shaped holes, and holes that have been tapped. And as it will not "catch," there is no danger in striking seams, blow holes and the like. Nor will it "draw in" or bind; hence it is peculiarly adapted to drilling copper, brass and the softer metals.

The resistance is reduced to the minimum, and a ¾ inch "Universal" drill can be used in the lathe with as much ease as a ¼ inch ordinary twist drill, and this, too, without the usual annoyance of clamping the work. In short it can be profitably put to a variety of uses where ordinary drills would be useless.

The drills of this company are made by a process altogether new and peculiar, whereby the steel is improved, and the drills are produced with uniformity as regards strength and sizes. The quantity as well as the quality of work this drill will do makes it an economical tool in the machine shop. These drills are made in all the usual sizes of twist drills. The factory of the Farmer Lathe-Drill and Tool Company is at Leominster, Mass.

When we shall have direct steam communication with Chili, we shall consult our interests by introducing our tools in the adroit manner that the English adopted. They sent over, while Chili was following primeval customs, an able mechanical engineer with a quantity of modern tools and machines. He put his plows and threshers in operation, explained the principle on which they worked and the advantage of their employment, and when any implement got out of order, he repaired it promptly. The result was very liberal orders, and a regular importation of farming utensils from England. It is believed that a fine opportunity exists to establish a large trade in farming machines; that our hardware, cutlery and edge tools may, with proper management, find a ready market in Chili, and that we may also share in the active purchases there of cotton fabrics, our fabrics being manifestly superior to those of the English. After shipping such goods, we may bring from the South Pacific nitrate and guano, for which we have a steadily growing demand, and which are now controlled by Chili. The Chilians are enterprising, are mainly concerned with agriculture and mining, and need, for their industries, the excellent implements we make, especially rock-drills, hoisting apparatus, iron pipes, engines, reapers, mowers, threshing-machines, plows, and the like. The English articles have found favor with the great landed proprietors; but, compared with our articles, they are clumsy, though solid, and too costly for middle-class farmers. Our factories can furnish every grade of implement desired by Chili, and, while yielding entire satisfaction to the minor farmers, can compete with the English for the patronage of the rich land-owners.

The State of Connecticut has taken measures to have a brilliant State exhibit at the approaching International Exhibition at Melbourne, Australia. Through her commissioner, Mr. Jno. E. Earle, the State has decided to select seventy-five prominent and representative industries, and Mr. Earle has been deputed to notify the firms nominated.

The Bucharest, Roumania, correspondent of *The London Times* says: "At a recent trial of self-binding reaping machines on the grounds of the Agricultural College here, the following four American makers were represented: Walter A. Wood, the Johnson Harvesting Machine Company, McCormick & Co., and C. Aultman & Co. The Aultman [Buckeye] machine won the first prize, the machine of McCormick & Company the second, and the machine of Walter A. Wood the third prize. The first-prize winner cut and bound five acres of wheat in four and a quarter hours. Mr. Lee, of Bucharest, has taken the agency of the Aultman machine, and has given an order for forty of them."

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☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers who fail to receive their paper promptly will please notify us at once.*

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Methods of Boiler Making.

While a great deal of information and carefully prepared advice about the safety of steam boilers, and boiler explosions, is being given to the public through the medium of the press, very few writers penetrate the subject deep enough to lay bare the prime causes leading to boiler accidents, and to suggest efficient and practical remedies. The Government has spent thousands of dollars in experiments to discover the cause of boiler explosions; and the boiler insurance companies have gathered and published a prodigious amount of valuable facts and opinions about the behaviour of steam generators, under various peculiar circumstances, for the information of boiler-makers and steam users. Experts have advanced and bolstered up by argument a number of plausible theories about explosions, each endeavoring to pull down the theories of the others. But what is the general result of all these investigations? In one respect they agree. The opinion is unanimous that a boiler constructed of poor materials and of poor workmanship is quite likely to give trouble, and is liable to cause a serious accident, even in charge of a competent engineer, while a boiler of good material and well made is virtually safe. A very large proportion of boiler owners will not engage competent and careful engineers to manage them; therefore the efficiency and reliability of the boiler must, or should be, assured in the shop where it is made. But it is not altogether owing to carelessness or lack of skill among boiler-makers that so many weak and dangerous boilers are made and sold, and go into use where they are believed to be safe. Competition in taking contracts leads to some extraneous risks. Almost any boiler-maker will study to produce a good, reliable article for the price agreed upon, making suitable allowance for cost of material, and work of construction. But if a staunch and durable boiler cannot be made with the facilities at his command at the contract price, there is a strong temptation to slight the work or put in inferior material or both. Boiler-makers will contend that purchasers are largely responsible for bringing about such a dilemma, inasmuch as they will not pay the real value of substantial, well-made boilers, but give their contracts to the lowest bidders, thus encouraging cheap and careless work and the use of inferior material. To an unpleasant extent, this has been true for the past few years, and the results are now almost daily brought to public attention by disastrous explosions, accompanied by the loss of life. But we see no probability of a radical remedy, except it comes from the manufacturers of boilers themselves. The great body of steam users will not become educated up to the point of paying 25 or 50 per cent. more for new boilers to one builder than another asks for the same.

Steam boilers can be made better and at less cost than they now are by improving methods of manufacture. Boiler shops, as a rule, are not remarkably progressive in adopting new machinery and methods for facilitating and improving their work. The workmen often resist attempts to introduce labor-saving devices into boiler shops, though, as graphically depicted by Chordal, in a late issue of the AMERICAN MACHINIST, successful devices of that kind contribute to give more work and higher wages. Holes in boiler plates are usually punched, thereby weakening the plates 35 to 40 per cent., while by drilling the holes from a third to a half of this loss can be obviated. But, by common methods, drilling is much more expensive than punching. What is needed is a machine capable of drilling several holes at once, and which will work automatically. Such a machine would be one of the most desirable equipments of a boiler shop. Steam, hydraulic and pneumatic riveting machines are in use, each proving efficient and economical, but most shops adhere to the slower and more expensive process of hand riveting. Flanging machines have been built, but so far as we can learn none have yet come into regular use. The successful development of a flanging machine offers a promising field for mechanical labor and experiment. Machines for bending plates are everywhere in use, but some of them are slow in operation. A machine for cutting off stay bolts quickly and without injury would be a very desirable adjunct to a progressive boiler shop, but we believe none have been successfully constructed, thus far, in this country, though they are in use in England. Hoisting apparatus is generally neglected in boiler shops, though a few shops are properly fitted up with such appliances.

Happily, modern improvements in the manufacture of boiler plates and tubes are such that a better article can be furnished for the price formerly paid for common stock, thereby encouraging boiler-makers to improve their methods of construction. We look to see substantial progress in this direction. The shops that are enterprising enough to adopt the most radical improvements are those that will do work the best, and at the lowest prices with satisfactory profits. They will also, as a natural consequence, secure the heaviest orders.

Accident in the Hudson River Tunnel.

At about five o'clock on the morning of the 21st of July, the gangs of workmen were being changed at the Hudson River tunnel, the one being relieved had passed out, and twenty-three of the new gang were already in the tunnel and five were in the air lock. The door leading to the tunnel had been opened, when a portion of the roof of the tunnel, adjoining the wall of the shaft, gave way. Three of the men who were in the tunnel rushed into the air lock and were quickly followed by the water. They quickly broke the heavy plate glass which formed the window in the air lock, which operation allowed some of the water and the air to escape. This relieved the pressure upon the door of the air lock, which, opening inward, could not be opened so long as there was any pressure within. The men opened the door just in time to save their lives, as the water from the river rushing through the porous earth, quickly filled the tunnel and the shaft, so that the twenty men who remained in the tunnel were drowned, which composed all of the gang, excepting the eight who escaped as described. All that could be seen from the surface of the ground after the accident was a depression just outside the wall of the shaft where the ground had sunken, the shaft being filled with water. For some time past the work of driving ahead had been abandoned for the purpose of replacing the temporary structure which formed the temporary entrance to the tunnel, by the permanent work. To accomplish this task, all the force were put to work at the task of making the change. The ground at this point is of a loose character, being filled in with cinders and rubbish, consequently water will pass through it like a sieve. Several small breaks had occurred from time to time, but were always discovered and stopped before doing any damage. From evidences now obtained, the air was allowed to escape, which removed the pressure in the tunnel, and the pressure being removed, the roof gave way, causing the catastrophe.

The arching is commenced with iron which is applied at the heading, and as the silt is removed, more plates are bolted on until they meet at the bottom. The laying of bricks is begun at the bottom and is finished at the top. The iron had already been applied at the top of the tunnel near the shaft, and was well braced by heavy timbers, but the silt forms a very treacherous foundation, and only by exercising the greatest care can an accident be avoided.

We cannot say that the workmen paid for their carelessness with their lives, because the gang who escaped destruction may have been equally to blame in not properly securing their work. The engineers cannot be blamed, for the work upon which the men were engaged was of a character upon which they were at liberty to use their own judgment, or rather depending upon their foreman who was drowned. It is an illustration of the effect the constant presence of danger has upon human nature, causing men to become indifferent and heedless.

There are certain general rules which should be adopted by all engineers in the prosecution of all dangerous work, viz.: to employ only the most careful men as overseers of the work. They should also be in possession of extra good judgment. Even such men will, after a time, become careless, and to prevent this they require almost constant admonition, to keep them in possession of a sense of the great responsibility which rests upon them, both in the safety of the lives of the men under their charge and an economical prosecution of the work. The accident referred to will not materially injure the permanent structure of the tunnel, which has now progressed a distance of about three hundred feet under the bed of the river.

As soon as the water is pumped out an examination will be made, which will furnish additional evidence as to the actual cause of the disaster.

The water is to be pumped by means of a centrifugal pump and engine which is attached to a frame and suspended in the shaft. The engine is driven by steam passing through a flexible hose, and as the water is pumped out, the engine and pump are lowered to accomodate the suction of the pump which has a suction pipe 6″ in diameter, and has a capacity of 1200 gallons per minute.

The difficulties in the way of removing the water are by no means small, as the tide rises and falls in the shaft.

As soon as the break can be repaired, the work upon the tunnel will be resumed. An excavation is soon to be made upon the New York side when the work will be pushed from both ends.

In the present issue, under the head of "Letters from Practical Men," may be found a communication from a reader, in which he takes exception to one of our answers to a question viz.: "that hard cast iron contains more carbon than soft cast iron." Our answer referred to iron in the raw state as it comes from the blast furnace, and not to iron that has been moulded, and has passed through an artificial process of hardening, called chilling. In the exception, as stated, we heartily agree with the writer. The question under consideration: "Why does solid iron float upon liquid iron?" has been discussed in some of the English papers, and is still a matter of speculation We would be pleased to hear further from any of our readers who may be informed on the subject.

The Philadelphia iron puddlers who have been on strike for some weeks, have had a new sliding scale offered them by the mill owners which they have rejected. There are some rumors (which we hope are unfounded) that workmen will be imported from Europe to take their places.

The prospects for the Firemen's State Convention at Auburn, N. Y., August 17, are excellent. Already a large number of manufacturers have accepted the invitation to be present with apparatus, and the Convention cannot fail to be of benefit to all firemen who attend.

On pages 2 and 3 of this issue of the AMERICAN MACHINIST will be found the first of a series of three articles on the correct formation of the teeth of spur wheels, by Prof. C. W. MacCord, of the Stevens Institute of Technology. The other two articles in continuation of the subject will appear in our issues of August 14th and 21st. There will be from twenty-five to thirty engravings used for illustrations. The long and studious practical experience of Prof MacCord in the laying out of gearing is sufficient assurance that these articles will prove unusually interesting and valuable, explaining, as they will, the most advanced and accurate principles and practice. We wish to call attention to the fact that *no algebraic formulas will be used* but the whole matter presented in plain English.

LITERARY NOTES.

FOSSICK'S IRON TRADE CHART.—One sheet on heavy paper, printed in gold and colors, size suitable for framing, 16x17 inches accompanied with chronological supplement. Price $1.00.

This chart is composed of a series of diagrams, which are laid out to a scale representing the years from 1830 to June 1st, 1880, and shows the fluctuations in the iron trade during these years. A person can obtain a better idea of the sudden changes in the prices of iron, and better understand how fortunes are made and lost in a very short time by a few minutes study of this chart, than could be gained by an examination of books which would occupy days. This chart will doubtless prove of deep interest to those engaged in or associated with the iron trade, as it represents all kinds of iron and steel, pig, bar and rails. It shows the rises and depressions, and amongst the rest, that the prices of iron fell last year to about the same prices as in 1843 and 1852. The highest points ever reached are shown to be in 1872 and 1873.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) J. E. S., Springfield, Mass., writes: 1. Will you please to inform me the average temperature in the tunnel now being built between New York and Jersey City, also the greatest average temperature in which men do work at different occupations and where? *A.*—The average temperature in the Hudson River tunnel is about 80° Fahrenheit, although at the present time it is about 90° which is owing to some changes being made in the workings. The temperature of the caissons of the East River bridge was 86°. As soon as everything is ready to drive ahead again it is expected to reduce the temperature below 80°. The greatest temperature that men have to endure is probably in the fire room of a steamship in the tropics. There are steamships that sail from New York, in the fire rooms of which the temperature after passing Cape Hatteras rises to 125° and 130°. We are informed that there are cases where the temperature has risen to 135°. The firemen labor during their watch, which is from four to six hours, depending upon circumstances. The work in sugar refineries and in iron puddling and blast furnaces also in steel works is very hot, but the temperature in these places does not reach the height above mentioned. 2. What is the highest temperature men could be in and exist for 5 hours time? *A.*—We understand from this that you mean pressure instead of temperature, as men require very strong physical constitutions to endure 130° and do much work. The air after being compressed for use at the Hudson River tunnel, is cooled before entering the shaft, otherwise the temperature would stand much higher. The pressure used at present under which the men work in the shaft of the Hudson River tunnel is 16 to 20 pounds per square inch, but instances are on record where a pressure of 6 atmospheres has been used. Such a pressure is dangerous however, and if continued for a period of time causes a sort of paralysis or loss of the use of the limbs. A sudden change from such an extreme pressure to a normal state is attended with great danger and sometimes death. The rule now adopted is one atmosphere per minute.

(2) P. W. L., Grinnell, Iowa, asks: Is there any way by which I can obtain a steady and even motion from a line shaft that runs uneven? The variations of the main shaft are very sudden at times. *A*—You may obtain an approximately steady motion from a line shaft which has a varying velocity, by the application of a balance wheel. This wheel may be applied to a countershaft through which the power may be transmitted, or it may sometimes be attached to the main shaft or whichever may be the most convenient, being governed of course by circumstances.

(3) D. M. D., Fitchburg, Mass., writes: A customer wants a boiler 16 ft. long and 5 ft diameter, with heads dished; no tubes, nothing but shell heads. It is desirable to carry a pressure of hot water 500 pounds per square inch, at a temperature of 200 degrees. There is to be no fire under or about the boiler. How thick and of what quality of iron or steel would you make this boiler and how would you rivet it? Would three rows of rivets in longitudinal seams be stronger than two? Please give all the information you can on the subject. *A.*—The following is an extract from the Rules and Regulations prescribed by the Board of Supervising Inspectors of Steam vessels, regulating the thickness of boiler plates, adopted 1877. Rule—"Multiply one-sixth (1-6) of the lowest tensile strength, found stamped on any plate in the cylindrical shell, by the thickness—expressed in inches or in parts of an inch—of the thinnest plate in the same cylindrical shell, and divide by the radius or half diameter—also expressed in inches—and the sum will be the pressure allowable per square inch of surface for single-riveting, to which add twenty percentum for double-riveting." The hydrostatic pressure applied under the above rule must be in the proportion of one hundred and fifty pounds to the square inch, to one hundred pounds to the square inch of the working pressure allowed. As the boiler desired will not be subjected to the action of a fire, the uneqaul expansion and consequent wasting away of the plates, which are to be provided for in the former case, may be left out of account in this. You should have informed us if the boiler is to be suspended from the ends, in which case due allowance should be made. We would recommend that you make the boiler either of homogenous steel 5/16 inch thick or the best iron 3/4 inch thick with double riveted seams, using rivets 7/8 inch in diameter, as a larger size is very difficult to drive in a satisfactory manner. The ends should be well dished, and when flanging the iron should not be bent too square but the corners left well rounded. The flange should be of a good width projecting well inside the shell. In regard to riveting we would say that chain riveting is now being more used than ever before. A report upon some tests made in England, if reliable, shows advantages in favor of chain riveting, although zigzag riveting is generally used in this country. This is a subject upon which the best engineers differ very much.

(4) T. C., Lockport, New York, writes: I had a casting 17 7/8" outside diameter given me to cut for a spur gear pattern. Please inform me two correct number of teeth that should be cut in it, No. 6 pitch. The pinion that is cast to match in the wheel cast from this pattern contains 24 teeth, and measures 4 2-6" outside diameter. Allowing 3-16" for shrinkage would leave the wheel from this pattern 17 11-16". I claim 104 teeth is what should be cut in a wheel of that size, No. 6 pitch. My boss and one or two workmen differ from me and claim that 106 teeth is correct, and I now wish to have your opinion on the subject. *A.*—The first part of your question is not stated as clearly as it ought to be, but taking your figures we find 104 teeth to be correct.

(5) J. I., New York City, writes: I use a 1" pipe for heating at 60 lbs pressure on boiler; total length of heating pipe 1400 feet. The water used is 55 gals. per hour. What is the value in Horse Power or how much water is generally used per Horse Power? *A.*—A cubic foot of water converted into steam in one hour is equal to one Horse Power. This is the standard to work from. In a cubic foot there are 1728 cubic inches, and in one gallon there are 231 cubic inches. By dividing 1728 by 231 we get 7.48 which is the number of gallons contained in a cubic foot. We now divide the 55 gallons, the amount of condensation per hour by 7.48 which will give a quotient of 7.33 Horse Power, nearly. In answer to the second question we would say that in calculating the power of steam boilers a cubic foot of water is usually taken as the equivalent of a Horse Power.

A. F., of Cleveland, Ohio, wishes to be informed if J. T., of Connersville, Ind., (whose question we answered in our issue of July 24, 1880) will require his engineer to examine his engine carefully to ascertain if it has a free exhaust, and communicate the information to the AMERICAN MACHINIST. Will J. T. oblige by complying with this request? His address has been mislaid.

Business Specials.

40 cts. a line for each insertion under this head.

Wanted by a Mech. Engineer and Draughtsman, 16 years experience, situation as Superintendent or Draughtsman. Address C. R., Box 444, Worcester, Mass.

Paper Making Machinery—Makers of above from fibrous material as wood, esparto grass, etc., send address to Joshua Rose, P. O. Box 3306, N. Y. City.

Upright Engines, 16x28 inch, in good order, and now running in this city, will be sold low. Belcher & Bagnall, 40 Courtlandt St., New York.

A 4½ in. 2 Jaw Chuck, Independent or Universal, for Brass Work. A. F. Cushman, Hartford, Conn.

For first-class machine work try Anderson Bros., Engineers and Machinists, Peekskill, N. Y.

Lathes, Planers, Shapers, Drills, Bolt and Gear Cutters, Milling Machines. Special Machinery. E. Gould & Eberhardt, Newark, N. J.

For Sale—Shapley & Wells Engine, 8 H. P., as good as new, lathe swing, 24 in. x 9 feet. T. & K., Box 246, Owego, Tioga Co., N. Y.

Engines, Hoisting and Pumping Machinery for Mines. The Band Friction Hoist, which is the safest, simplest, strongest and best in the market. Also, Friction Clutches. Address, Webster Camp & Lane Machine Co., Akron, O.

American Watch Tool Co., Waltham, Mass., Whitcomb Watch Makers' Lathes, and Watch Machinery.

Dixon's Traction Belt Grease. Dixon's Founders' Perfect Wash. Dixon's Plumbago Foundry Facing. Dixon's Graphite Machine Grease. Dixon's Everlasting Graphite Axle Grease. Dixon's Dry American Graphite Perfect Lubricator. Send for explanatory circular to Dixon Crucible Co., Jersey City, N. J.

Power Shears. Stiles & Parker Press Co., Middletown, Conn.

Wilkinson & Crowell, 1201 Beach St., Philadelphia, make an Improved Metallic Piston Rod Packing, which is entirely automatic and of great durability. Works well at high or low pressure, and can be used in common stuffing box, or without any stuffing box at all.

See Standard Turbine advertisement in last issue.

Norris & Rutter, Mechanical Draughtsmen and Patent Solicitors, 424 Walnut Street, Philadelphia.

W. Barnet Le Van, Mechanical and Consulting Engineer, 3607 Baring Street, Philadelphia, Pa.

John Douglass, common and fine patterns made to order, also car wheels, working models, and experimental machinery. Shop at Washburn, Hunts and Co's Wheel Foundry, cor. Warren and Bay Sts., Jersey City, N. J.

Engines Indicated—Power Measured. W. H. Odell, Box 274, Yonkers, N. Y.

Sheet Metal Presses. Ferracute Co., Bridgeton, N.J.

Manual of Power for Machines, Shafts, and Belts, with the History of Cotton Manufacture in the United States, by Samuel Webber, C. E., copyrighted 1879. Only work of the kind extant; 240 pages. Price $3. Address, D. Appleton & Co, New York, or the author, Manchester, N. H.

MANUFACTURES.

Bloomington, Ill., moulders have just received an advance of ten per cent.

Thomas C. Cadugan has established machine works at Springfield, O.

There is talk of starting an agricultural implement factory at Springfield, O.

The amount necessary to secure the building of a silk factory in Allentown, Pa., has been subscribed and the enterprise is now an assured fact.

The Peoria, Decatur & Evansville Railroad Co., are erecting shops at Mattoon, Ill. The round house will have stalls for ten engines.

Newly incorporated California companies: The Berry & Place Machinery Co.; capital stock, $50,000. Directors, John J. Sherburne, J. F. Place, W. B. Bradbury, W. O. M. Berry and Jonathan Kittredge. The Gordon Hardware Co. The directors of the latter are James E. Gordon, Chas. E. Stone, A. A. Cox, Charles K. Clark and George B. Adams. The amount of the capital stock is $200,000.

J. A. Fay & Co., Cincinnati, O., write us: "We are still crowded in every department of our works, and are compelled to fill orders in turn as received."

The tack factory of Burgess & Howland, Taunton, Mass., is approaching completion.

A large dry-house is now being erected by the Grand Rapids Chair Co. A fire-proof building for the storage of oils and other finishing materials, is also being built to replace that recently burned.

McCracken, Stark & Co., is the style of a new firm about engaging in the manufacture of brackets and fancy cabinet-ware in Philadelphia. They have leased the five story factory building at 1235 Pine Street, and are now fitting it up with the necessary machinery.

Most of the machine shops, says the Philadelphia *Trade Journal*, have orders for months ahead, and are working full time.

Along the line of the Philadelphia and Reading Railroad and its branches, within six weeks, fourteen iron furnaces have been closed to make repairs and wait for a steady market.

Keeley is shortly to produce another motor, guaranteed to "mote," says a Philadelphia exchange.

The Illinois Secretary of State issued license July 5, to organize the following corporations of Chicago: Franklin Fuel Company; capital, $25,000; corporators, Horatio Pratt, Frank W. Balch, and Paul H. Kelley. Illinois Malleable Iron Works; capital, $25,000; corporators, John Dunham, Alex. Dunham, and Ira D. Owen.

The Illinois Secretary of State has licensed the Chicago Self-coupling Car Company, Capital, $250,000. Corporators, J. J. Wheat, Abraham Kimber, and Treat T. Prosser.

The Farrel Foundry and Machine Company of Ansonia, Conn., have sold their interest in the Waterbury concern to E. C. Lewis, who has organized a joint stock company with a capital of $100,000. The stockholders are: E. C. Lewis, 3,140 shares; W. E. Fulton, 400 shares; G. B. Lamb, 400 shares; Hobart W. Curtis, 40 shares; L. F. Wolff, 20 shares. The value of the shares is $25 each.

Thomas Wood, of Philadelphia, is shipping power looms to South America.

Bottomly & Cady, of Athol, Mass., have leased the mill formerly occupied by E. E. Partridge near the Orange line at Branchville, and will manufacture shoddy blankets.

The Billings & Spencer Company, of Hartford, Conn., have recently added a new building of 20x40 feet to their works, and put in three new drop hammers.

A jute carpet factory is to be established at New Orleans.

With an eye to coming events, the Novelty Manufacturing Company of Glen's Falls, N. Y., are engaged manufacturing campaign torches. They received an order from Pennsylvania for 200 dozen as a start.

Stock has been subscribed and arrangements completed for starting a glove manufactory at Randolph, N. Y. One of the editors of the Jamestown *Journal* says he has been led to believe that the young ladies of that village had started a mitten factory, but he had seen no account in the newspapers of such an enterprise.

Report says a large woolen mill is to be be erected at Gilbertsville, Mass., next year.

William Clark & Co., of Pittsfield, Mass., have built for E. D. Jones two large rag-engines to go to Japan.

The Everett Mills, of Lawrence, Mass., have just put in a 200 horse-power engine, built by Armington & Sims of that city. The cylinder is 18½"x30", and the engine makes 120 revolutions a minute. It can be pushed to 300 horse-power with 80 pounds of steam.

A new tissue paper mill is to be erected in Northampton, Mass. Vernon Bros. put in the water privilege and other property, and New York parties the mill.

Ware, Mass., proposes to offer inducements to manufacturers to locate in that town.

The New York Mills at Saco, Me., will have a capacity of about 400,000 spindles.

The Lewiston, Me., Machine Co. pay a semi-annual dividend of 4 per cent.

Murdoch McRae, of Robeson, S.C., is about to erect a cotton mill, to be operated by the Clement attachment, near the State line.

Mr. David Bradley, of the manufacturing company of Furst & Bradley, has purchased of the real estate firm of Garnett & Thomasson, a lot at the northwest corner of Green and Fulton streets, 150x150 feet. The sum paid for the property was $10,000. Mr. Bradley intends soon to cover the lots with a large manufacturing establishment.—*Chicago Journal of Commerce.*

At Minneapolis, Minn., has just been completed a flouring mill which is thought to have no equal as to size in the world. The floor space occupies 180,000 square feet of surface, or about four acres, and the structure contains 2,757,000 feet of lumber.

J. A. Killebrew, Commissioner of Agriculture, Statistics and Mines for the State of Tennessee, says, in a recent report, that the cost of producing "hot-blast, stone coal mill and foundry iron made of brown and red hematite," in East Tenessee, will not exceed $11, and $16 for Bessemer pig made of magnetic ore.

The Syracuse, (N. Y.) Chilled Plow Co. have increased their capital from $150,000 to $300,000, added a new building 40x216 feet, employ 200 hands and will turn out 30,000 plows this year.

There is a rumor to the effect that a morocco factory, to employ from 150 to 200 hands, is soon to be erected at Pennsgrove, N. J.

A new glass bottle house will be built in Ottawa, Ill., this season. About one hundred hands will be needed. The firm propose to begin making bottles on or about the 1st of September.

One hundred hands in Wells & Co.'s mill, Ft. Madison, Wis., struck against working eleven instead of ten hours for the same wages.

Steps are being taken for the erection of a $20,000 new process cotton factory at Paris, Taxes.

The firm of C. S. & S. Burt, manufacturers of Shingle Machinery at East Dubuque, Iowa, have consolidated with Novelty Iron Works, and the shops are being enlarged.

A large oatmeal mill, with an investment of $40,000, and a large fruit-canning establishment, are among a number of new and important manufacturing enterprises which add this year to the commercial enterprises of Muscatine, Iowa.

The Baltimore Bridge Company has contracted to construct for the Vicksburgh, Shrevesport and Pacific Railroad an iron bridge across the Ouachita River, at a cost of between $125,000 and $150,000.

Wills, Schafer & Miller have erected a flouring mill and grain elevator at Gregory's Landing, Mo.

The Boyle Ice Machine Co. of Chicago propose to establish a factory in Charleston, S. C.

Cadle, Mulford & Co., of Muscatine, Iowa, whose planing mill burned some time ago, are now rebuilding on a more extensive plan.

James Breckenbridge, of Pennsylvania, recently purchased of John Russell 1,000 acres of timber land near Grayson, Ky., for the purpose of cutting the timber into staves and lumber. The saw-mill machinery has arrived, and will soon be in operation.

A paper and pulp mill is in course of construction at Kaukauna, Wis.

A Boston company has purchased 1,400 acres of wood land near Glen Sutton, Quebec, and will erect a large building for the manufacture of butter tubs.

The outfit of machinery for the Arkansas Manufacturing Company at Little Rock, who are to have the most complete and extensive cotton seed oil mill in the United States, is being manufactured by the South St. Louis Foundry Company. The first batch of machinery to be made will consist of more than 150 tons of castings, and there will be several such.

The British royal navy are to equip twenty-four of its vessels with the Brush electric light, and $80,000 will be paid on the order, which is being filled in Cleveland, Ohio.

The Schenectady Locomotive Works have now contracted for and in course of construction fifty locomotives, mostly of the larger sizes, to be delivered as rapidly as possible.

A few weeks ago some parties went to Fayetteville, N. Y., from Chittenango, saying they wished to start a knife factory in the place if the citizens would subscribe liberally to the enterprise. After considerable wrangling, in a meeting of citizens, a subscription list was started, and soon $1,000 was raised, which made the company conclude to locate there. But the mechanics, lumbermen and tradesmen were astonished to see all the workmen, lumber and supplies brought from Syracuse and neighboring villages.

F. H. Whiting, Youngstown, O, writes us: "Brown, Bonnell & Co. are making some substantial improvements. They have built and nearly furnished machine, boiler and blacksmith shops in a continuous brick building. The machine shop is two stories high, the rest one, all roofed with corrugated galvanized iron. The power for the building is furnished by a 14"x28" Reynolds-Corliss engine, which runs the following machines in the machine shop: large double and two single roll lathes, one 60", one 36", one 18", and 2 12" lathes; a 60"x50" planer, and one small one; a shaper; a radial drill and drill press, and a bolt and pipe cutter, and the necessary tools in the pattern, boiler and blacksmith's shops. They are also putting up a Cuyahoga blast engine, 36"x48" steam cylinder, and 84"x48" air cylinder, in a substantial brick engine house, 26 ft. x 35 ft., roofed the same as the machine shop, together with two batteries of two boilers each, 50" x 24 ft., with two 17" flues."

The Piedmont Cotton Factory, in Greenville County, S. C., is to be duplicated, which will make it the largest cotton factory, with but one exception, in the South. Fifty houses are being erected for the operatives. During the past year the mill netted 30 per cent. on the stock subscribed.

Messrs. Bolckow, Vaughan & Co., proprietors of the Eston Steel Works, Cleveland, England, are about commencing work with their fifteen-ton converters, made specially for the manufacture of steel from Cleveland iron. These are said to be the largest steel works in the world.

Rockford, Ill., is to have a glucose factory with a capacity of 3,000 bushels of corn per day. It will be located on an island a little below the city.

The Wellsville, Ohio, rolling mill, which has been stopped three years, has again begun operations under the management of W.& D Wood, of McKeesport, Pa. It is now known as the "Wellsville Plate and Sheet Iron Company."

The recently destroyed shoddy mill in East Douglass, Pa., is to be rebuilt at once. The big mill is to be of the same proportions as the one burned, 50x100, five stories, but this time it will be built of brick.

A new foundry and car works are going up at Easton, Pa.

The Scranton (Pa) new silk works will soon begin operations.

The Phoenix Iron Company, Phoenixville, Pa., whose new mill is to run with gas for fuel, are ready to start.

Seventy laborers at the Eagle Iron Works, Green Island, N. Y., struck recently against a proposed reduction of from 20 to 50 per cent in wages. The strikers held a meeting and elected an executive committee.

The present Piedmont cotton factory in Greenville county, S. C., is to be duplicated in buildings, machinery and operatives in a short time, which will make it the largest cotton factory in the South except one.

The Raritan Woolen Mills Company are completing a new mill to be called the Somerset Mills, located at Raritan, N. J., which is to be run on fancy cassimeres.

The rolling mill at Fall River, Mass., employs about 300 hands, and the nail mill employs 148.

Machinists' and Engineers' Supplies.

NEW YORK, July 22, 1880.

This week shows more activity in the supply market. The gradual stiffening of the iron market has culminated in an advance in the price of pig, which of course affects all manufactured iron. There has been a perceptible and general stiffening in supplies for the past four weeks, and at the present time the feeling is excellent and the outlook good. The Billings & Spencer Co., Hartford, Conn., write us that they are extremely busy and are not able to fill their orders. They have just put in two 400 lb, one 250 lb. and one 600 lb. drop hammers, also two more trimming presses in their forging shop, and could run half a dozen more if they had them. They say "There is very little chance, under the circumstances, to keep cool this season." This enterprising company has just produced a new Double Acting Rachet Drill, also several other new tools and implements which are illustrated and described in their catalogue just issued.

F. Chillingworth, of New Haven, Conn., is introducing a new and successful device for grinding hardened lathe centers, for use in machine shops generally.

Sweetland & Co., of New Haven, Conn., after long and costly experiments, have succeeded in producing all parts of their chuck, so as to interchange. Pieces of the chuck may be taken from a number indiscriminately, and are found to fit together with the same nicety as if they were fitted particularly for each other. This is the first time we are aware of the perfect interchanging of parts of chucks. The hole in the center is made larger than heretofore, and a full bite or bearing can be taken upon the jaws.

A. H. Downer, 17 Peck Slip, New York, is manufacturing and introducing a new compound for leather belting. It is called Beltoleum, and is used for the purpose of rendering leather belting soft and pliable, without causing the leather to become spongy, or causing it to stretch uneven. It is claimed to be made of only animal, mineral and vegetable oils, and free from all substances injurious to leather possessing the properties of having no unpleasant odor, and does not become rancid. It being a liquid, is quickly and easily applied. When applied, it soon penetrates the leather and does not form a gum upon the surface.

The uses and advantages of a good lubricator for belts in increasing their durability are obvious and well understood. We are informed that the manufacturer furnishes samples for trial when requested.

The Farmer Lathe Drill and Tool Co., Leominster, Mass., after over two years experimenting, are prepared to offer to machinists and the trade their "New Universal Lathe Drill," engravings of which appear upon another page of the present issue. They also make drills for special purposes and in the near future will produce some specialties in the way of machinist's small tools that will be in the nature of a new departure.

Iron Review.

NEW YORK, July 22, 1880.

The pig iron market is buoyant, and prices have an upward tendency. The selling price of No. 1 foundry is fully $3 higher than it was when it touched the lowest point a few weeks ago. Stocks of No. 1 are comparatively light, other grades are more plentiful. An advance of $2 a ton has taken place within two weeks. We quote No, 1, $25, No. 2, $23 to $24, and Forge, $22 to $23.

Scotch pig is sold quite largely. Prices are $2½ a ton higher than they were one month ago. We quote Eglinton, $22, Coltness, $25, and Glengarnock, Gartscherrie and Summerlee, $23.50.

Manufactured iron has an improved appearance but prices remain the same.

Pierson & Co., 24 Broadway, N. Y., under date of July 22, 1880, quote prices out of store as follows:

Iron Rails, $50 to $57, according to weight; Fish Plates, 2¾c. per lb.; Railway Spikes, 3c.; Bolts and Nuts, 3½c.; Common Bar Iron, 2.4c., basis from store; Refined do. 2.6c., basis; Ulster, 3.6-10c. basis; Machinery Steel, 6½c.; Best Tool Steel, 13½c.; Norway Bar Iron, 6¼c.; Norway Shapes, 6¾c; Nail Rods, 6¾c.; Sheet Iron, 3½c., basis; Angle Iron, 3¼c.; Tee Iron, 3¾c.; Band Iron, 3.4c.; Hoop Iron, 3.6c., and up according to size; Horse Shoe Iron, 3.3c.; Hot Polished Shafting in lengths, 2 ft. and longer, 9 to 10½c., according to size; Small Black Rivets, 30% off in papers; 10% off in bulk.

Carmichael & Emmens, 130 Cedar St., New York, quote prices of Boiler Makers' Supplies as follows:

Flange, 5¼c.; C. H. No. 1 Shell, 4c.; Tank, 3½c.; C. No. 1, 3¾c.; Sheet, 3½c; Angles, 3½c. Boiler Tubes 45% discount from list.

Metal Review.

LUCIUS HART & CO., 8 & 10 Burling Slip, New York, furnish us the following, under date of July 22nd, 1880:

A fair jobbing business has been done during the last week in metals. Pig Tin very strong with an upward tendency; London £91 and Singapore $28. We quote this market to-day, Banca Tin, 22¼c; Malacca and Straits, 21c. to 21¼c.; Billiton and Australian, 20¼c. to 20¾c.; English Refined, 20½c. to 20⅝c.; Lamb and Flag, 20¼c., sellers not anxious to push stocks at above prices. Pig Lead dropped from 4¾c. to 4½c., but has since rallied, now quoted 4¾c. to 5c., for small lots. Antimony unchanged, cheap lots about disposed of, Cookson, 18c.; Hallet, 16½c. to 17c.; Copper, 19c. for Ingot; Spelter, 6c. for Foreign, and 5½c. nominally for Domestic. Nickel, $1.25, Solder, No. 1, 11c., "Half and Half," 13c.

WANTED.

Wanted—Machinists—Six strictly first-class Vise hands and Fitters accustomed to building machine tools; liberal wages paid by Niles Tool Works, Hamilton, Ohio.

An experienced machinery iron works Superintendent wishes to engage with reliable parties. Address, P. H. L. care AMERICAN MACHINIST office.

A thorough Machinist desires office work as accountant or draughtsman; or would do fine light machine work or fine brass finishing. Has filled every position in shop. Address Inventor, office AMERICAN MACHINIST.

I will pay $1.00 for a good copy of the first issue of the AMERICAN MACHINIST, Nov. 1877. H. Veeder, Plattsburgh, N. Y.

FOR SALE.

A Works completely equipped for the manufacturing of carriage axles; is well located in relation to Coal and Iron, also very accessible to market. Address

E. P. BULLARD,
14 Dey Street, New York.

Mechanical Books.

Send 10 cents for 96 page Catalogue of Books for Machinists and Engineers.

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Drawing Instruments

AND MATERIAL, PAPER, &C.

G. S. WOOLMAN,
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Fully priced and illustrated Catalogues.

J. A. FAY & CO.'S (CHICAGO STORE,) Keep in stock a full line of **Wood-Working Machinery** of their own manufacture. (Shops, Cincinnati, O.)

Agents for and keep in stock Lathes, Planers, Drill Presses, Steam Pumps, Emery Wheels, Blowers, Belting and Supplies, from first-clas makers. J. A. FAY & CO., 97 & 209 Lake St., Chicago. J. A. Roche, Manager.

THE FARMER LATHE-DRILL & TOOL CO.

LEOMINSTER, MASS., U. S. A.

MANUFACTURERS OF

Drills and Machinist's Small Tools.

Attention given to making Drills for special purposes, either straight, flute or twisted. Also, manufacturers of the New Patent Lathe-Drills, to which we would call the attention of those who work in Copper, Brass and the softer metals. For price list and further information address as above, or

L. B. RUSSELL, Gen. Agent,
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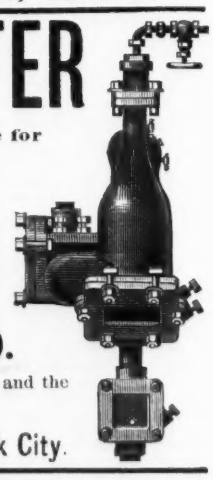

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TO WHOM IT MAY CONCERN: New York, May 1st, 1877.

We have used the Files made and re-cut by Messrs. KEARNEY & FOOT for the past three years, and we know of no better recommendation than the fact that we are still using them.

FLETCHER, HARRISON & CO.

WINCHESTER REPEATING ARMS CO.

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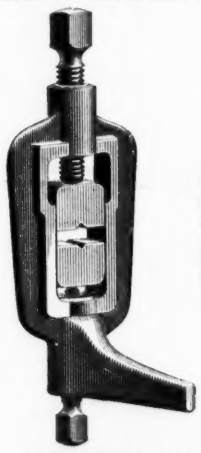

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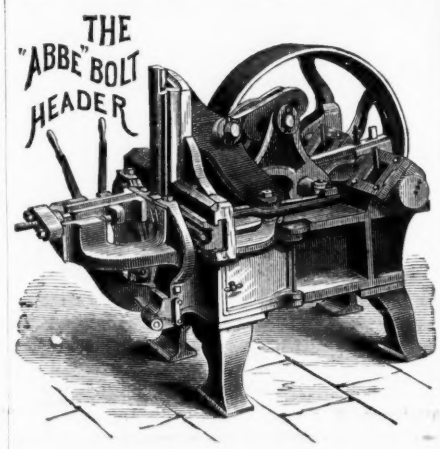

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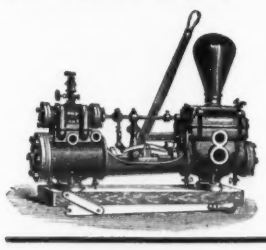

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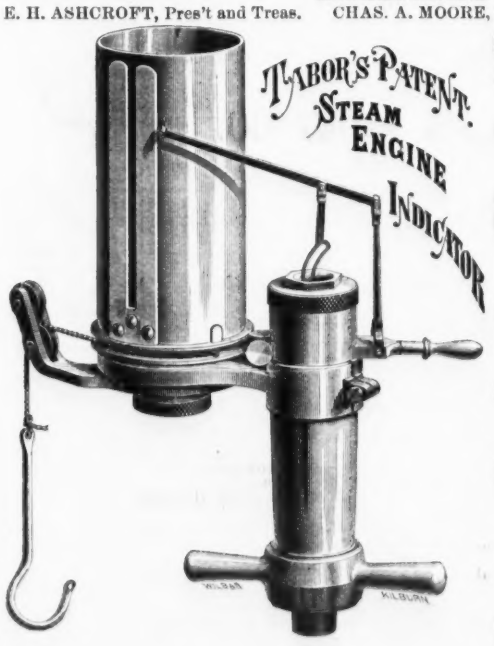

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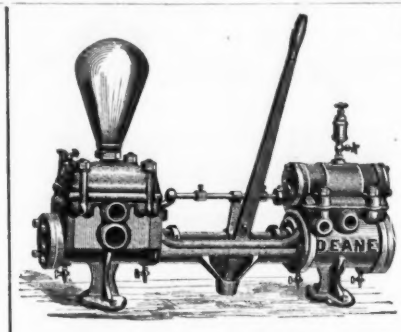

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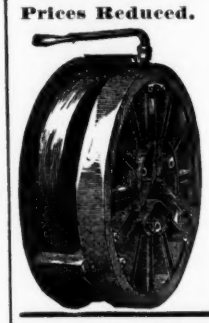

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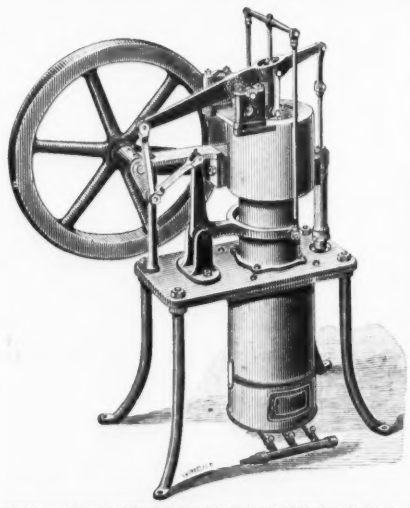

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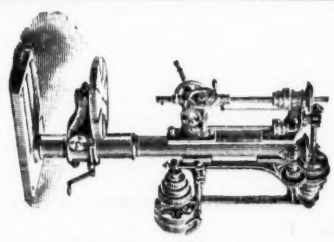

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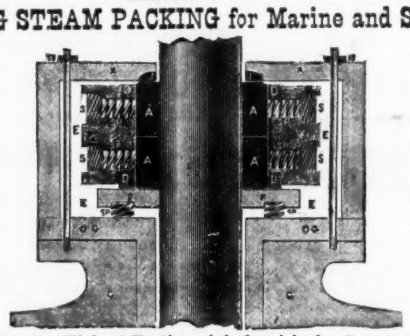

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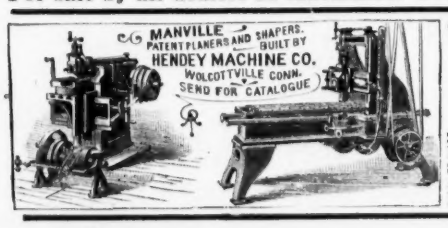

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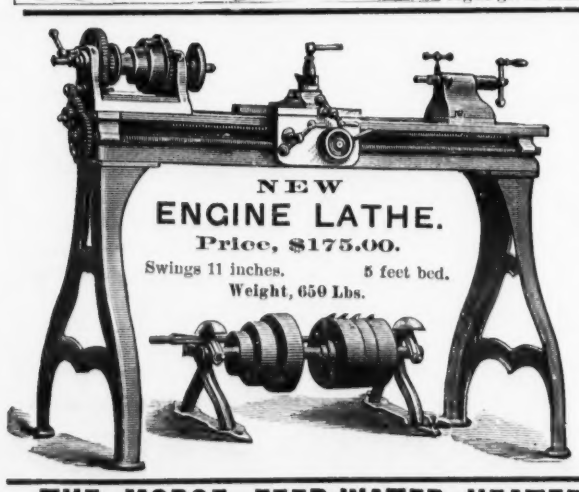

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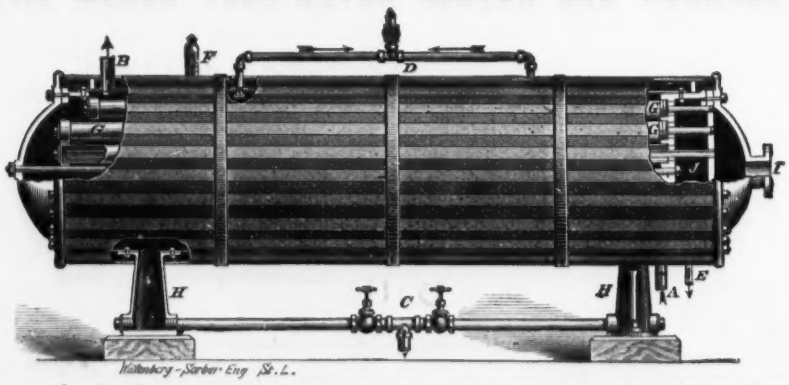

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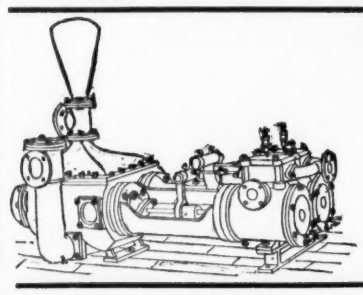

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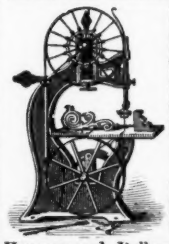

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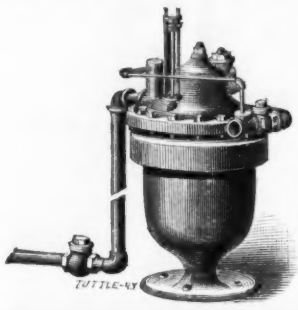

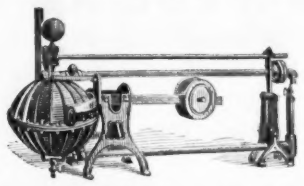

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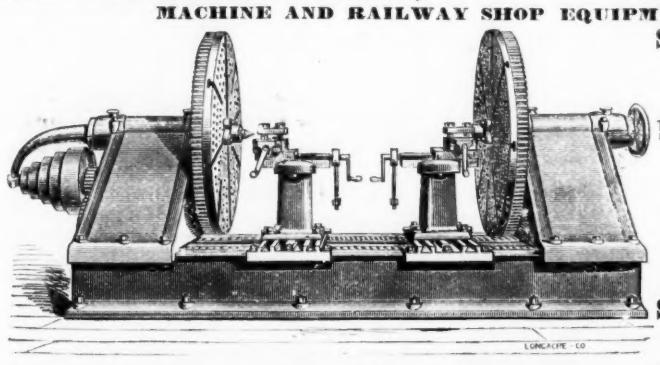

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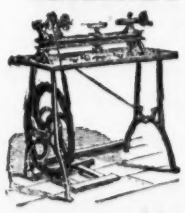

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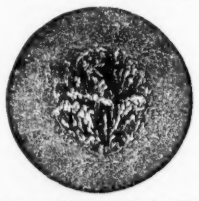

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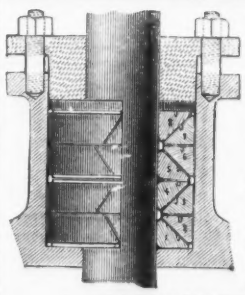

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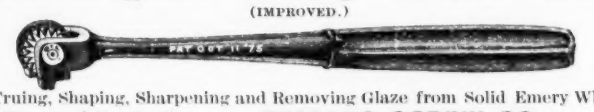

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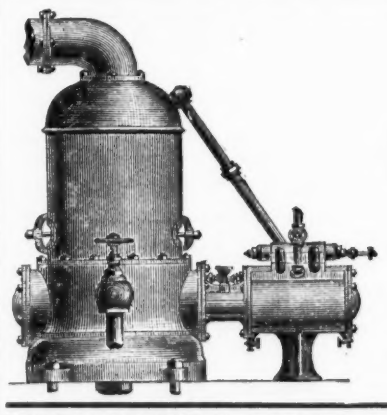

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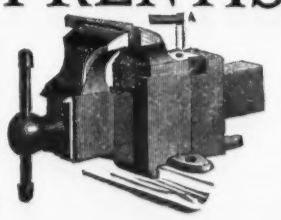

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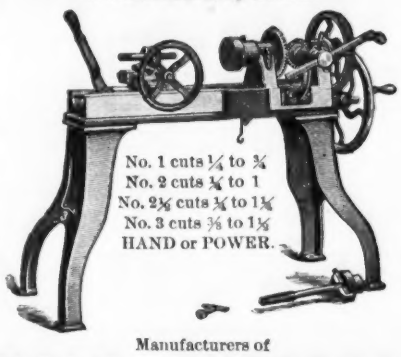

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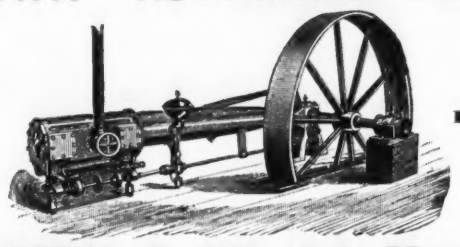

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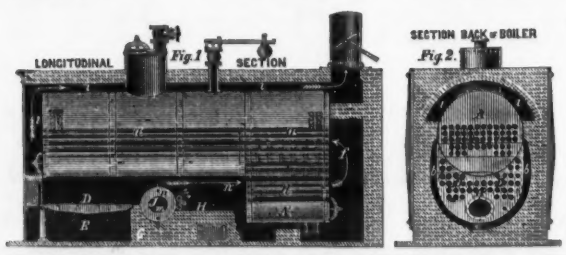

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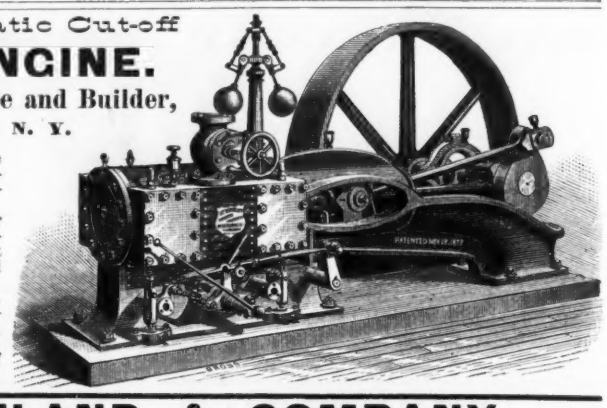

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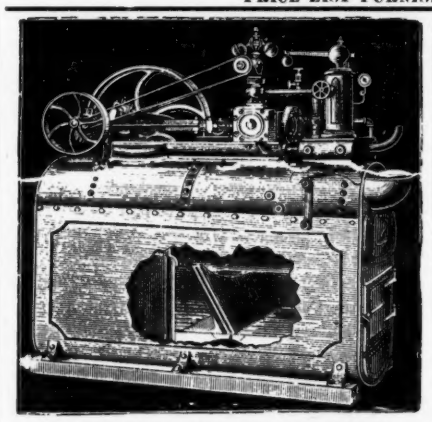

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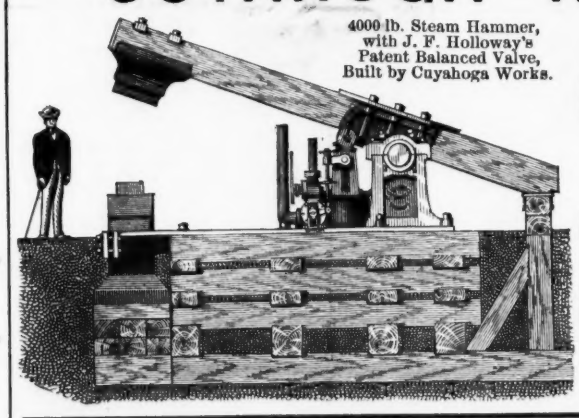

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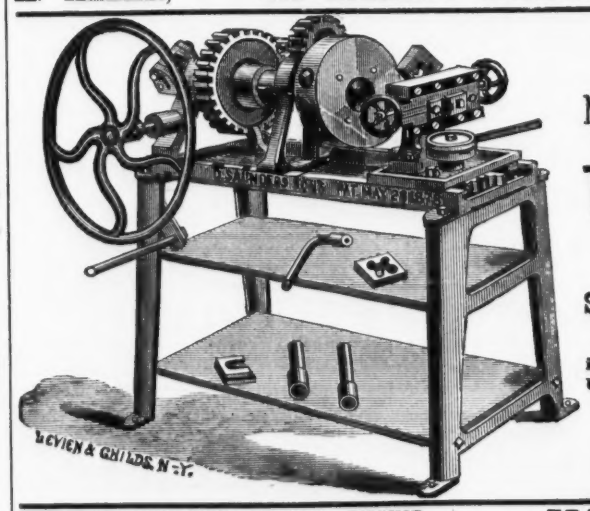

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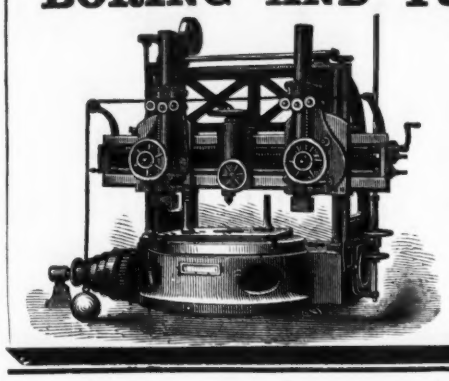

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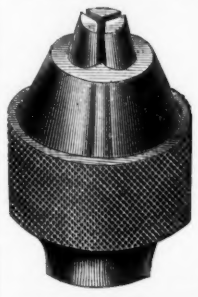

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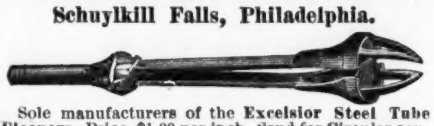

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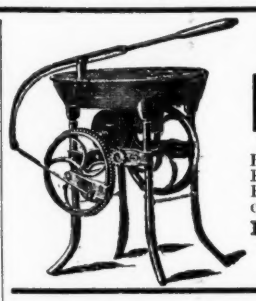

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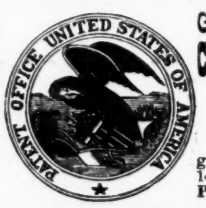

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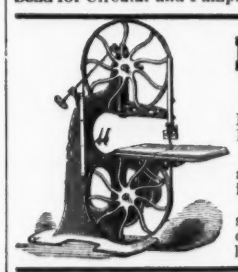

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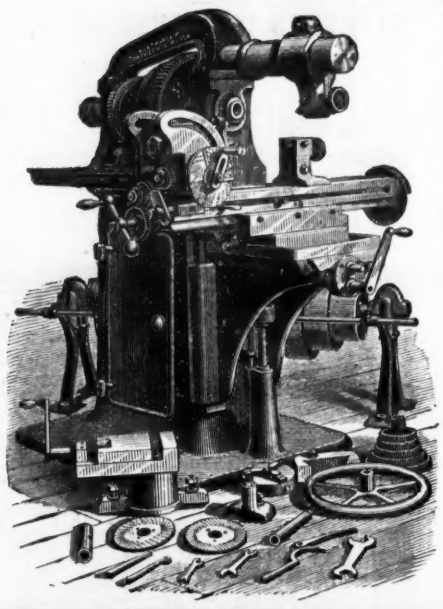

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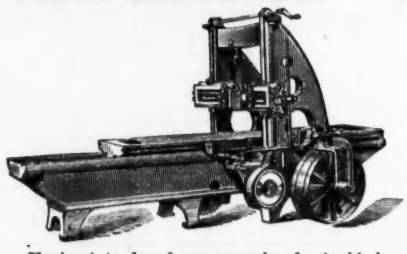

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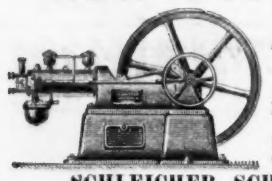

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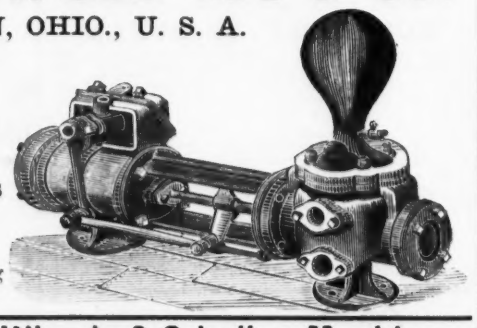

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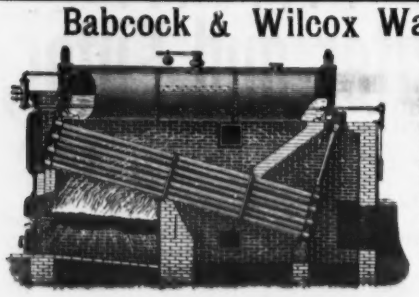

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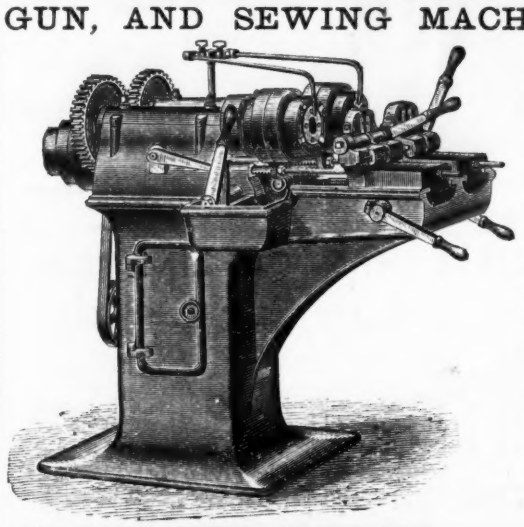

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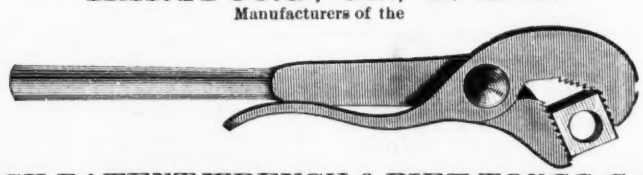

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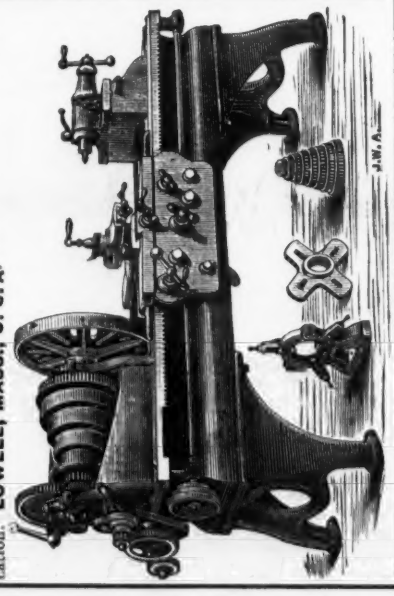

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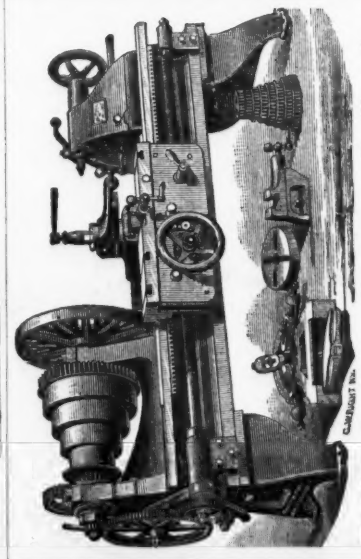

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